INSTRUCTION MANUAL

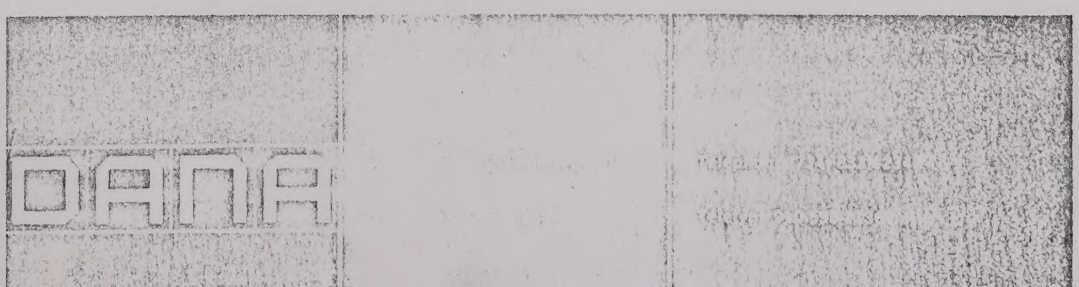
ELECTRICAL OUTPUT AND
PROGRAMMING ACCESSORIES
MODEL 5500 DVM

RACAL-DANA

Instruction Manual
980217

ELECTRICAL OUTPUT AND PROGRAMMING ACCESSORIES MODEL 5500 DVM

February, 1967



ISOLATED ELECTRICAL OUTPUT AND PROGRAMMING ACCESSORIES
DANA MODEL 5500 DIGITAL VOLTMETER

INTRODUCTION

This manual describes the isolated accessories available for use with the Dana Model 5500 Digital Voltmeter. The accessories allow operation with non-isolated equipment with no loss in the common-mode characteristics of the voltmeter. This is achieved by the use of guarded reed relays between the instrument and all external input/output lines.

The basic accessories and their identifying model numbers are listed in the following table:

Isolated Electrical Output	Model 73
Isolated Programming	Model 74
Isolated Electrical Output/Isolated Programming	Model 75

The isolated output can be adapted to the format requirements of a wide variety of printers and other digital output devices by use of a diode matrix which converts the internal digital voltmeter code to the desired BCD output. The more commonly used codes (1-2-4-8 and 1-2-2-4) have been standardized and assigned option numbers. Other BCD codes can be provided on special order.

The output voltage levels are produced by a switch closure to an externally supplied reference voltage. The user can, therefore, obtain the desired voltage levels by specifying either a switch-closure for a "false" bit or a switch-closure for a "true" bit. An open switch, of course, represents the complementary state. With contact-closure "true" specified, negative true outputs are obtained when a positive reference voltage is supplied; positive true outputs are obtained when a negative reference is supplied. With a contact-closure "false", the output sense is reversed.

The two options described above are designated by a suffix to the basic accessory model number:

1-2-4-8 with switch-closure "true" is designated as D1.

1-2-4-8 with switch-closure "false" is designated as D2.

1-2-2-4 with switch-closure "true" is designated as E1.

1-2-2-4 with switch-closure "false" is designated as E2.

For example, a Model 5500 DVM having basic accessory Model 75 with 1-2-4-8 code, switch-closure "true" is identified as 5500-75-D1.

Physically, each basic accessory is a plug-in unit that is inserted into the rear of the voltmeter. It includes a printed circuit "mother-board" which contains nine connectors into which additional printed circuit boards are placed. The nine connectors are designated as J101 through J109. Four types of boards are used; the quantity of each is determined by the basic accessory model. The complement for each basic accessory is shown in the table below:

	Isolated Output Boards					Isolated Programming Boards		Range Funct Code Board	Delay Board
Basic Accessory	J101	J102	J103	J104	J105	J106	J107	J108	J109
Model 73	X	X	X	X	X		X	X	X
Model 74					X	X	X		X
Model 75	X	X	X	X	X	X	X	X	X

The electrical outputs of each accessory are delivered through connector J202; programming inputs are made through J204. The connectors are mounted side-by-side on the rear panel of the DVM (see Figure 1). Specific pin assignments of the connectors are listed on the "Pin Assignments and Coding" chart.

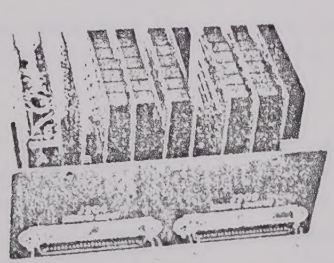


Figure 1

ISOLATED OUTPUT BOARDS (J101 through J105)

The Isolated Output circuit boards are used in basic accessories 73 and 75 only- since Model 74 does not deliver an electrical output. The boards contain guarded reed relays that provide isolation between the digital voltmeter circuits and the output device. They also contain diode matrices to convert polarity and overrange information into the desired BCD output format. The configuration of a typical output bit (X1) is shown in Figure 2.

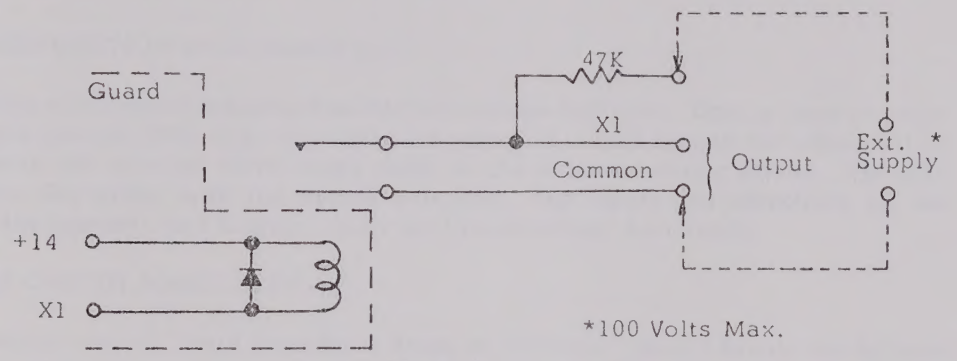


Figure 2

When the X1 input from the DVM digitizing circuits is at digital common, relay K1 is energized. This places the X1 output at common. When K1 is not energized, The voltage at the X1 output is dependent on the external supply voltage. Relay K1 is energized on either the "true" or "false" DVM outputs depending on the option selected. This is determined by the diode matrix in the Decades of the digital voltmeter.

ISOLATED PROGRAMMING BOARD (J106 - J107)

The configuration of a typical Isolated Programming input circuit is shown in Figure 3. Both boards are used in Models 74 and 75; one board (J107) is used in Model 73.

The command for a selected function or the coded range selection is made by supplying a common to the appropriate pin on the Programming Input connector. One side of each programming relay is tied to one side of each of the other relays and to the EXTERNAL +12 volt supply supplied by user.

Current flow through a closed circuit is approximately 6 milliampere. Care should be exercised that only one function and/or range is commanded at a time. Response time to a program command is approximately 10 milliseconds.

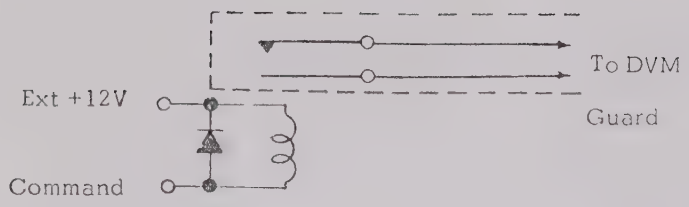


Figure 3

RANGE/FUNCTION CODE BOARD (J108)

The Range/Function Code board contains two diode matrices. One is used to convert the internal DVM function code to the selected output format; the other matrix converts the internal DVM range code to the selected output format. Specific coding may differ with the option selected. The codes are identified on the "Pin Assignments and Coding" chart for the particular accessory.

DELAY CIRCUIT BOARD (J109)

The delay circuit board provides a delay or "timeout" period to provide settling time for the input accessories (used with AC, DC, Kilohms, or MV measurements) and to allow time for the DVM to change ranges when operating in Auto Range. At the end of the delay period, the Print Command is generated.

A simplified diagram of the Delay Circuit is shown in Figure 4. This general configuration is used with Models 74 and 75. Model 73 has a simplified delay circuit (described at the end of this section.)

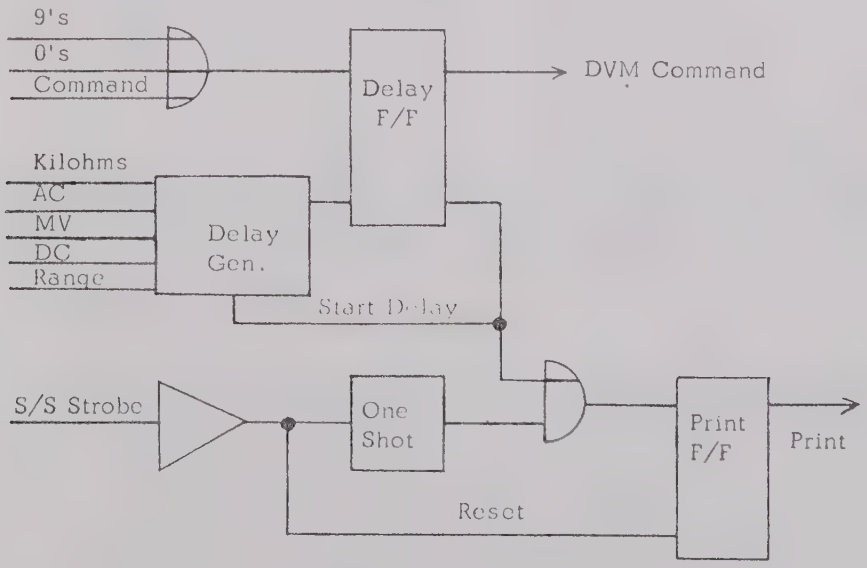


Figure 4

The DVM Command signal is generated by the Delay flip-flop. This flip-flop is turned on by external command or by the 0's and 9's signals from the Decades indicating that either an up or down range change is required.

Setting of the Delay flip-flop is inhibited by a signal from the Delay Generator. The output of the Delay Generator is "true" for a time determined by the selected function. Delay times for each function are listed below. After the indicated delay period, the Delay flip-flop is allowed to set, the DVM Command signal is generated, and the conversion begins. At the start of a conversion, Start/Stop (S/S)goes positive and the output of the inverting amplifier, shown in Figure 4, goes negative. The negative-going inverter output triggers the one-shot which, after it times out,(in 15 milliseconds) sets the PRINT flip-flop, thereby generating PRINT. If, after a conversion period, a range change is required, setting of the PRINT flip-flop is inhibited by the Delay flip-flop. Another DVM Command is generated and S/S again goes positive — with no PRINT being generated.

Type of Measurement	Delay
DC Volts - Fast	50 ms
DC Volts	600 ms
AC Volts	600 ms
Millivolts	2 sec
Ohms (up to 1 meg/range)	2 sec
Ohms (10-meg range)	20 sec

In Accessory Model 73 that has no range or function programming capability, the External Command is strapped directly to the DVM Command input, no delay generator or flip-flop is used. The Start/Stop strobe is applied to a one-shot to provide the delay for the digital circuits (15 milliseconds).

PIN ASSIGNMENTS AND CODING

The following table identifies the pin connections of the Programming input connector (J204) and the Electrical Output connector (J202) for each of the basic accessories.

REMOTE INPUT CONNECTOR J204

	PINS		
1 Range	1	26	100 Range
10 Range	2	27	1000 Range
10,000 Range	3	28	
	4	29	AC
Ratio	5	30	MV
DC Fast	6	31	K Ohms
DC	7	32	Hold *
Command *	8	33	
Delayed Command	9	34	
	22	47	
	23	48	
	24	49	
+12 Volts *	25	50	

*Model 73 is equipped with these lines only

ELECTRICAL OUTPUT CONNECTOR J202

		PINS		
Range	(X1)	1	26	Range (X3)
Range	(X2)	2	27	Range (X4)
Polarity	(X1)	3	28	Polarity (X3)
Polarity	(X2)	4	29	Polarity (X4)
Units	(X1)	5	30	Units (X3)
Units	(X2)	6	31	Units (X4)
10's	(X1)	7	32	10's (X3)
10's	(X2)	8	33	10's (X4)
100's	(X1)	9	34	100's (X3)
100's	(X2)	10	35	100's (X4)
1000's	(X1)	11	36	1000's (X3)
1000's	(X2)	12	37	1000's (X4)
10,000's	(X1)	13	38	10,000's (X3)
10,000's	(X2)	14	39	10,000's (X4)
100,000's	(X1)	15	40	100,000's (X3)
100,000's	(X2)	16	41	100,000's (X4)
Function	(X1)	17	42	Function (X3)
Function	(X2)	18	43	Function (X4)
Range	(X5)	19	44	
		20	45	
		21	46	
		22	47	
Print Command #		23	48	
External Ref. #		24	49	
Common #		25	50	

#Model 74 is equipped with these lines only

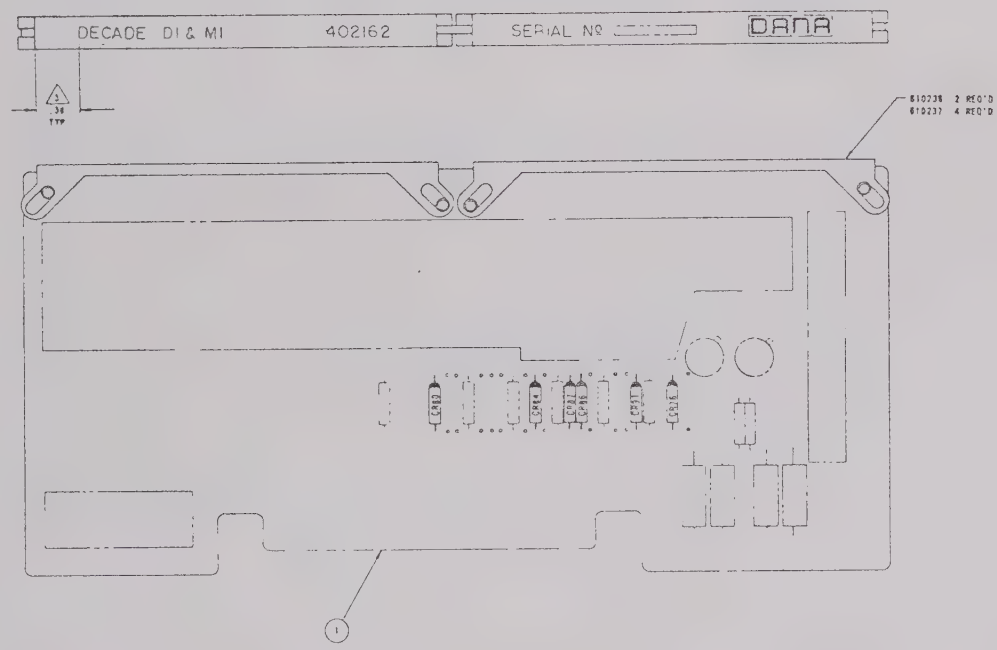
OPTION	D1	D2	E1	E2
Code Switch Closure	8-4-2-1 True	8-4-2-1 False	4-2-2-1 True	4-2-2-1 False
Codes:				
Range 1	0100	0100	0110	0110
10	0011	0011	0011	0011
100	0010	0010	0010	0010
1000	0001	0001	0001	0001
10,000	0000	0000	0000	0000
DC	0001	0001	0001	0001
Ratio	0010	0010	0010	0010
DC Fast	0011	0011	0011	0011
AC	0100	0100	0110	0110
MV	0101	0101	0111	0111
Kilohms	0110	0110	1100	1100
+Polarity	0000	0000	0000	0000
-Polarity	0001	0001	0001	0001

Note: Two additional output codes are present when the 040 Integrator Accessory Module is used: (1) a "7" (0111) indicates MVF (unfiltered millivolts); and (2) in an instrument with a D1 or D2 output option, the "8" bit is always true when Integrate is selected. Therefore, the function indications of 1 through 7 become 9 through 15 in Integrate mode.

Table 1. Pin Assignments and Coding - Models 73, 74, and 75

Drawing	Model 75				Model 74	Model 73			
	D1 Option	D2 Option	E1 Option	E2 Option		D1 Option	D2 Option	E1 Option	E2 Option
Decade*	402162	402343	402342	402357	402162	402162	402343	402342	402357
Basic Schematic	430487	430487	430487	430487	———	430489	430489	430489	430489
Overall Schematic	430551	430598	430599	430600	430491	430551	430598	430599	430600
Wiring Diagram	430593	430594	430593	430594	430593	430593	430594	430593	430594
Isolated Output (J101, 102, 103, and 105) - Assy.	402151	402151	402151	402151	402367*	402151	402151	402151	402151
Isolated Output - Schematic	430481	430481	430481	430481	430589	430481	430481	430481	430481
Overrange or Isolated Output (J104) - Assembly	402151	402151	402151	402151	———	402151	402151	402151	402151
Overrange or Isolated Output - Schematic	430481	430581	430481	430581	———	430481	430581	430481	430481
Isolated Programming (J106) - Assembly	402150	402150	402150	402150	402150	———	———	———	———
Isolated Programming - Schematic	430480	430480	430480	430480	430480	———	———	———	———
Command/Hold or Isolated Programming (J107) Assy.	402150	402150	402150	402150	402150	402165	402165	402165	402165
Command/Hold or Isolated Programming - Schematic	430480	430480	430480	430480	430480	430472	430472	430472	430472
Range and Function Coding (J108) - Assembly	402149	402359	402360	402361	———	402149	402359	402360	402361
Range and Function Coding - Schematic	430479	430581	430582	430583	———	430479	430581	430582	430583
Delay (J109) - Assembly **	402171	402171	402171	402171	402171	402170	402170	402170	402170
Delay - Schematic	430478	430478	430478	430478	430478	430477	430477	430477	430477
*Basic Decade Assembly 400891 used with all options. **Sub-assemblies 402152 and 402153 used on all Delay assemblies.					*Used in J105 only				

Model 5500 DVM Output Accessory Drawing List



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P N	ITEM NO
1	400891A	P C BOARD ASSY - DECADE BCD BASE			

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES .X ± .03 .XX ± .01 FORMED ANGLES ± 3°

MATERIAL

FINISH

CONTRACT NO

DRAWN — 1/2/YR

CHECKED D BYNE

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASSY —
DECADE OUTPUT OPTION
1248 NEG TRUE

SIZE D | DWG NO - - - 402162 | REV 1A

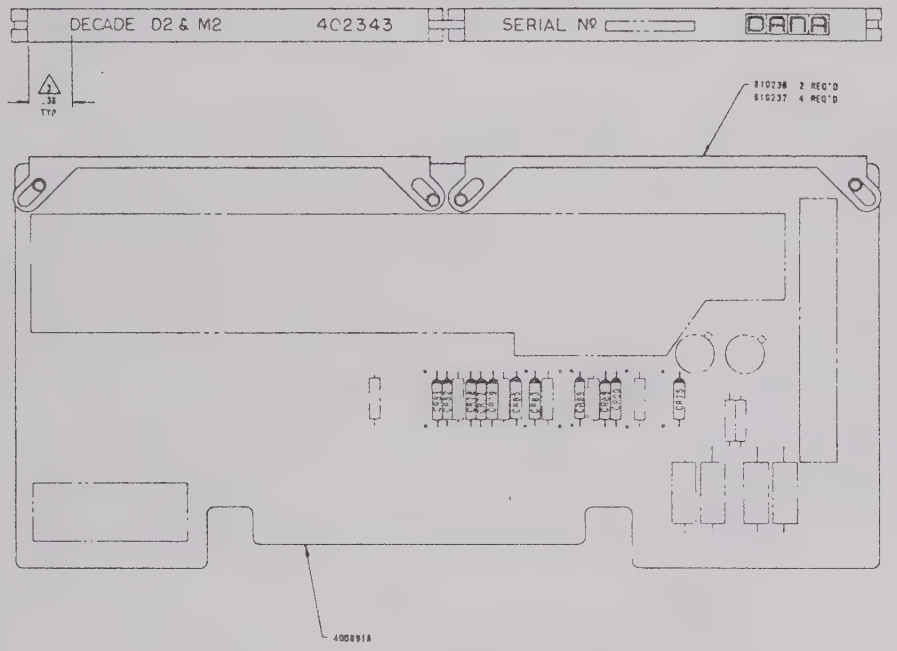
SCALE 2:1 | WT | SHEET OF

ITEM NO	PART NO	NOMENCLATURE OR DESCRIPTION	QTY PER ASSY
5	400852	MOD 5 U	5
6	400851	MOD 4 DI	6
5	400849	MOD 3 DI	5
4	400848	MOD 2	4
4	400847	MOD 1	4
4	[illegible]	[illegible]	4
1	[illegible]	P C BOARD	1
REV LTR		REVISION	DATE APPROVAL

ASSEMBLY | GTY PER

4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN
2. SCHEMATIC REFERENCE 430348
1. ALL DIODES TYPE 810

NOTE: UNLESS OTHERWISE SPECIFIED



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
5	400583	MOD 78-D2			
5	400577	MOD 75-D2			
4	400574	MOD 65-D2			
4	400568	MOD 63-D2			
4	400567	MOD 61-M2			
NEXT ASSY	USED ON	APPLICATION	MA	FA	QTY REQD

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .020 XX .010 .XXX .010 | ANGLES 0° 30' | FORMED ANGLES ±5

MATERIAL SEE L/M

FINISH

CONTRACT NO.

DRAWN	ABBOTT	8/67
CHECK	TOFT	8/67
QUAL ENGR	D PAYNE	8/8/67
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

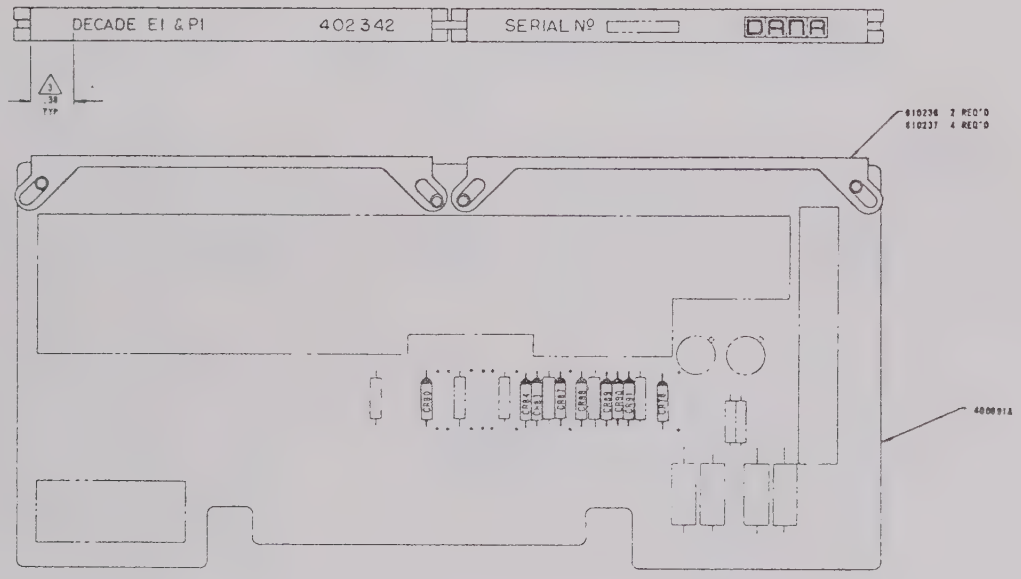
PC BOARD ASSY —— DECADE OUTPUT OPT D2 & M2
1-2-4-8 POS TRUE

SIZE	CODE IDENT NO	DWG NO	REV
D	——	402343	A

SCALE 2:1 | WT —— | SHEET 1 OF 1

4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO. LOCATED AS SHOWN
2. SCHEMATIC REFERENCE: 430385
1. ALL DIODES TYPE 810

NOTE: UNLESS OTHERWISE SPECIFIED



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P N	ITEM NO
5	400394	MOD 75 E			6
5	400378	MOD 75 E			5
4	400375	MOD 45 E			4
4	400391	MOD 45 E P1			4
4	400392	MOD 45 P1			4

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.03, XX ±.01, XXX ±.005; ANGLES 0° 30'; FORMED ANGLES ±0

CONTRACT NO.

MATERIAL: STEEL/M

FINISH

DRAWN: L ABBOTT 12-23-74
CHECK: T ORT
ENG: W WAYNE

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

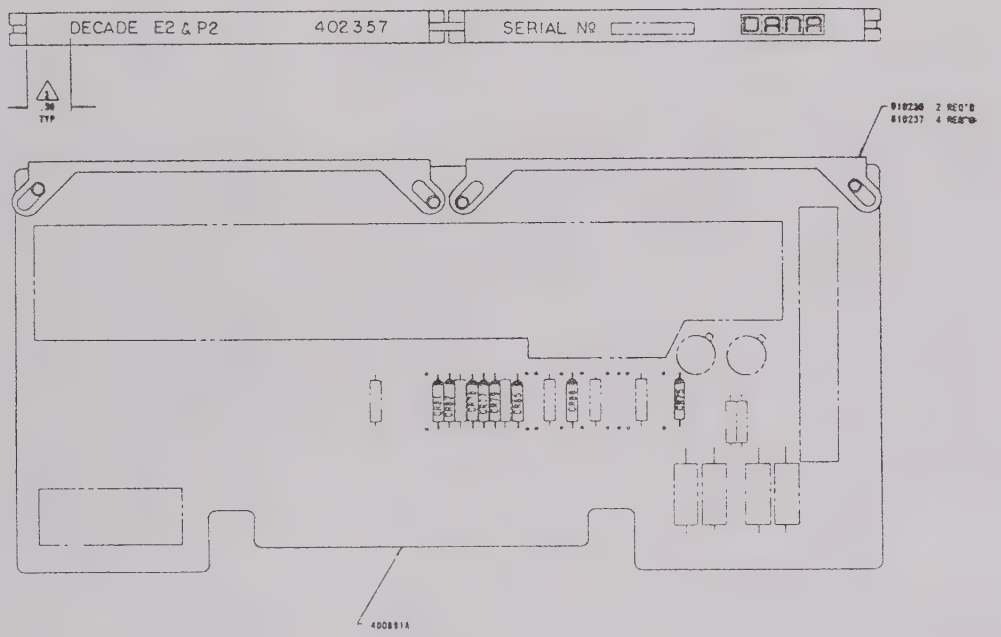
PC BOARD ASSY ——
DECADE OUTPUT CPTE. & P1
1-2-2-4 NEG TRUE

SIZE: D | CODE IDENT NO: — | DWG NO: 402342 | REV: A

SCALE 2-1 | WT —— | SHEET OF

4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. HEAT STAMP TO MIGH BLACK CHAPACTERS AND .13 MIGH LOGO. LOCATED AS SHOPN
2. SCHEMATIC REFERENCE: 430372
1. ALL DIODES TYPE D18

NOTE. UNLESS OTHERWISE SPECIFIED



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
5	M0075E2				5
5	M0073-E2				5
4	M0065E2				4
4	M0063-E2				4
4	M0063 P2				4
NA	FA				
APPLICATION		QTY REQD			

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X .030, XX .010, XXX .005; ANGLES 0° 30'; FORMED ANGLES 10

MATERIAL: SEE L/M

FINISH

CONTRACT NO.

DRAWN M. BERGS 1-6-67

CHECK —SET—

ENG —TO RANK— 1-6-67

MFG —

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

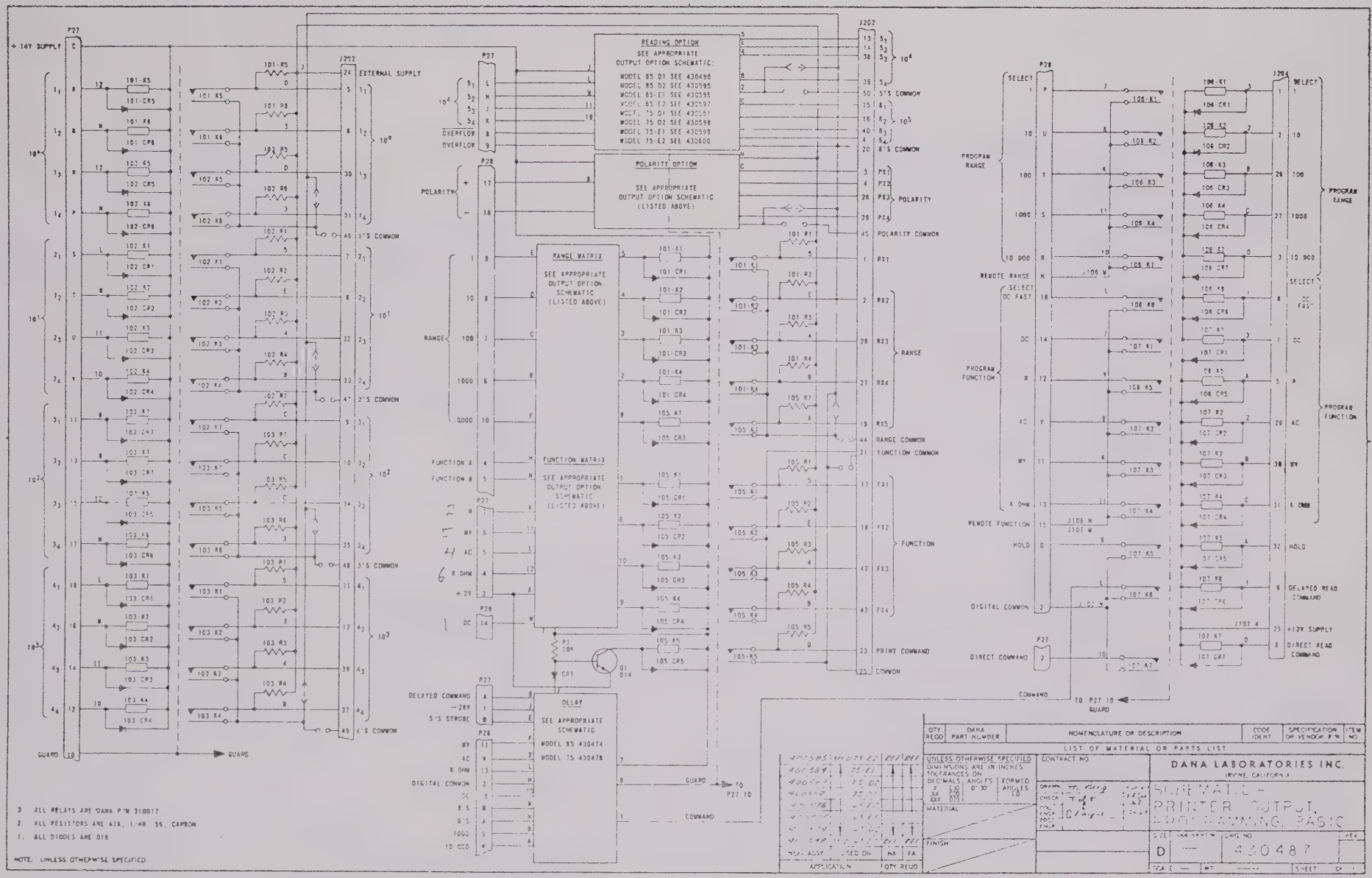
P.C. BOARD ASSY —
DECADE OUTPUT OPT E2/P2
-2-2-4 POS. TRUE

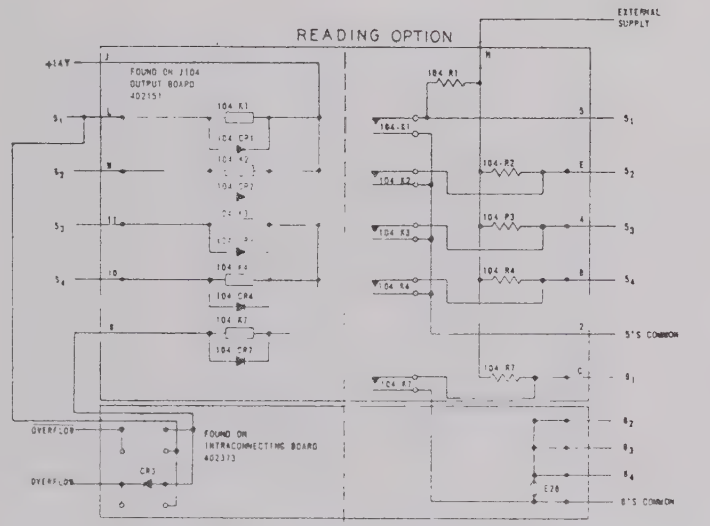
SIZE D | CODE IDENT NO —— | DWG NO 402357 | REV A

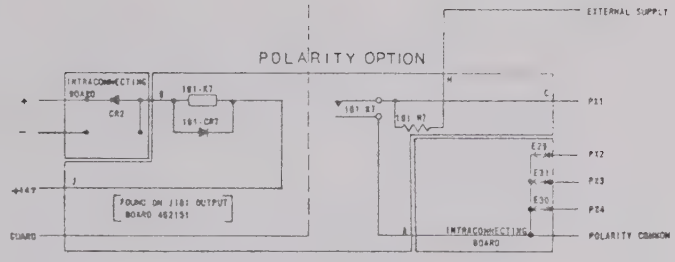
SCALE 4 - 1 | WT —— | SHEET —— OF ——

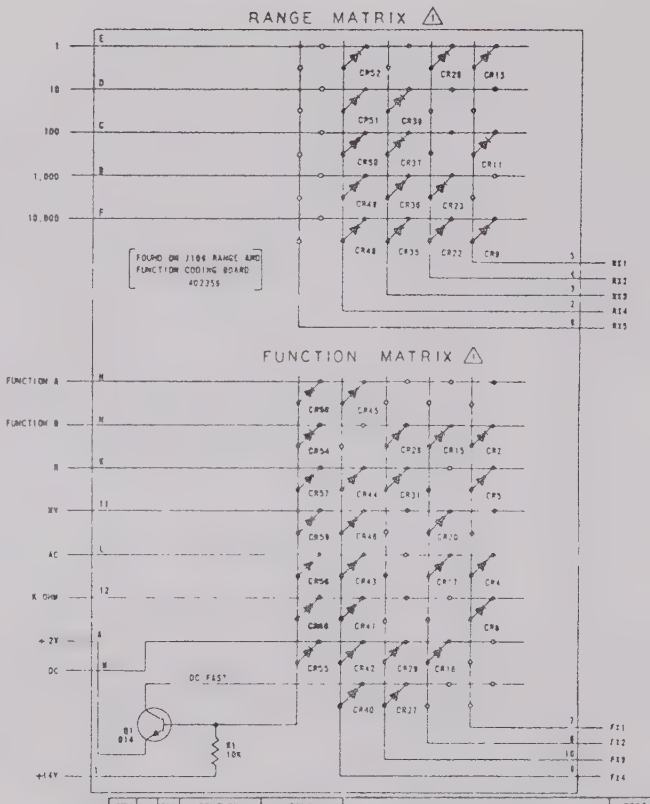
4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .13 HIGH LOGO LOCATED AS SHOWN
2. SCHEMATIC REFERENCE 430579
1. ALL DIODES TYPE 818

NOTE: UNLESS OTHERWISE SPECIFIED


+ 14V SUPPLY
P27
J202
EXTERNAL SUPPLY
READING OPTION
SEE APPROPRIATE OUTPUT OPTION SCHEMATIC:
MODEL 85 D1 SEE 430498
MODEL 85 D2 SEE 430595
MODEL 85-E1 SEE 430595
MODEL 85 E2 SEE 430597
MODEL 75 D1 SEE 430551
MODEL 75 D2 SEE 430598
MODEL 75-E1 SEE 430599
MODEL 75-E2 SEE 430600
POLARITY OPTION
SEE APPROPRIATE OUTPUT OPTION SCHEMATIC (LISTED ABOVE)
RANGE MATRIX
SEE APPROPRIATE OUTPUT OPTION SCHEMATIC (LISTED ABOVE)
FUNCTION MATRIX
SEE APPROPRIATE OUTPUT OPTION SCHEMATIC (LISTED ABOVE)
DELAY
SEE APPROPRIATE SCHEMATIC
MODEL 85 430474
MODEL 75 430478
OVERFLOW
POLARITY
RANGE
FUNCTION A
FUNCTION B
DELAYED COMMAND
-28V
S-S STROBE
MV
AC
K OHM
+2V
DC
DIGITAL COMMON
1000
10 000
P28
J204
PROGRAM RANGE
PROGRAM FUNCTION
REMOTE RANGE
REMOTE FUNCTION
DIRECT COMMAND
HOLD
SELECT
DC FAST
DELAYED READ COMMAND
DIRECT READ COMMAND
+12V SUPPLY
GUARD
COMMON
TO P27 10 GUARD
ALL RELAYS ARE DANA P/N 310017
ALL RESISTORS ARE 47K, 1/4W 5% CARBON
ALL DIODES ARE D18
NOTE: UNLESS OTHERWISE SPECIFIED
QTY REQD
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
CODE IDENT
SPECIFICATION OR VENDOR P/N
ITEM NO
LIST OF MATERIAL OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
FORMED ANGLES
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
QTY REQD
CONTRACT NO
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SIZE
CAGE NO
DWG NO
D
430487
SCALE
WT
SHEET







4. RESISTORS ARE 47K, ½W 5%, CARBON
3. ALL RELAYS ARE 310017
2. ALL DIODES ARE 414
1. ALL DIODE REFERENCE DESIGNATORS ON RANGE MATRIX AND FUNCTION MATRIX ARE PREFIXED 104

NOTES UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

400583	75-D2			
400577	75-D2			
NEXT ASSY	USED ON		NA	FA
APPLICATION			QTY REQD	

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
X ± .010 ± 0° 30'
XX ± .005
XXX ± .015
FORMED ANGLES ± 1.0°
EDGE MAY NOT BE FLUSH ON ONE SIDE BUT MAY NOT EXCEED 0.010"
MATERIAL AND WORKMANSHIP IN ACCORDANCE WITH STANDARDS MIL-STD-1000 AND MIL-D-70327

CONTRACT NO.

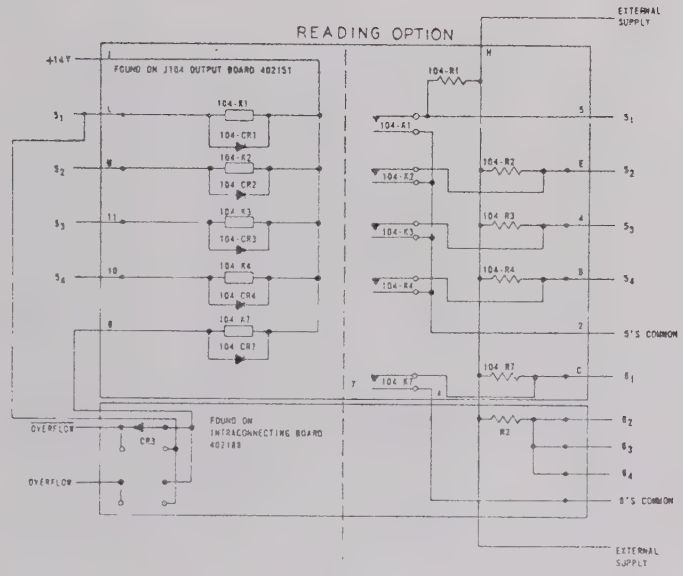
	NAME	DATE
DR		1-24-67
CHK		1/26/67
APPD		

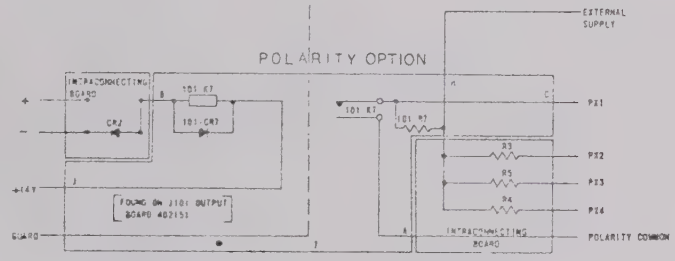
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

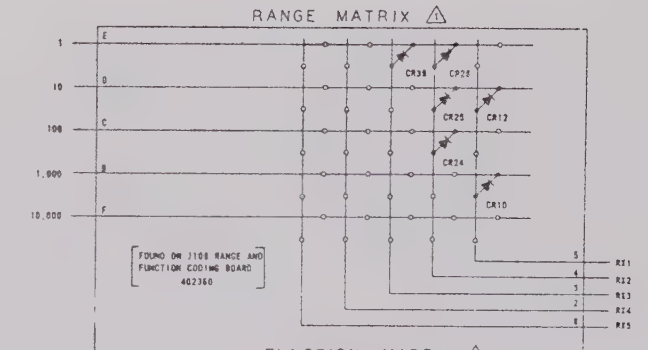
SCHEMATIC-
OPTION 73-D2, 75-D2,
1-2-4-8 CLOSURE FALSE

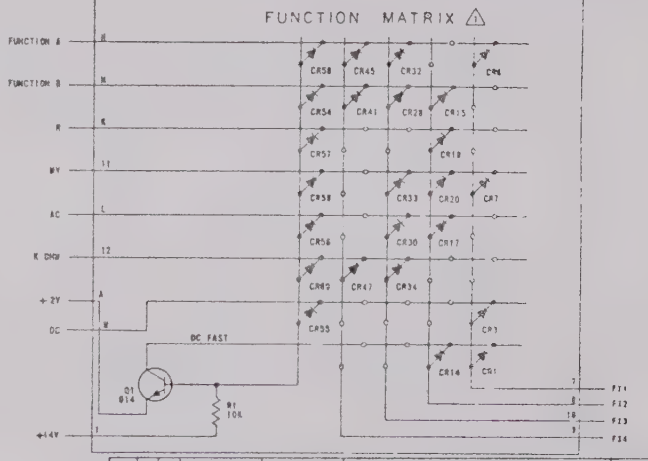
SIZE	CLOSE JOINT NO	DWG NO
D	—	430598

SCALE — WT — SHEET 1 OF 1









QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

400384	73-E1	REF	REF	
400378	73-E1	REF	REF	
NEXT ASSY	USED ON	MA	FA	
APPLICATION		QTY REQD		

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ± ANGLES ± 0° 30'
2 PL ± .010
3 PL ± .005
X.XX ± .015
X.XXX ± .013 ± 15'
ECCENTRICITY BETWEEN (4) OF THE SAME ⌀ SHALL NOT EXCEED .010 T.I.R.
ANY INVOLT DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	1-20-67
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

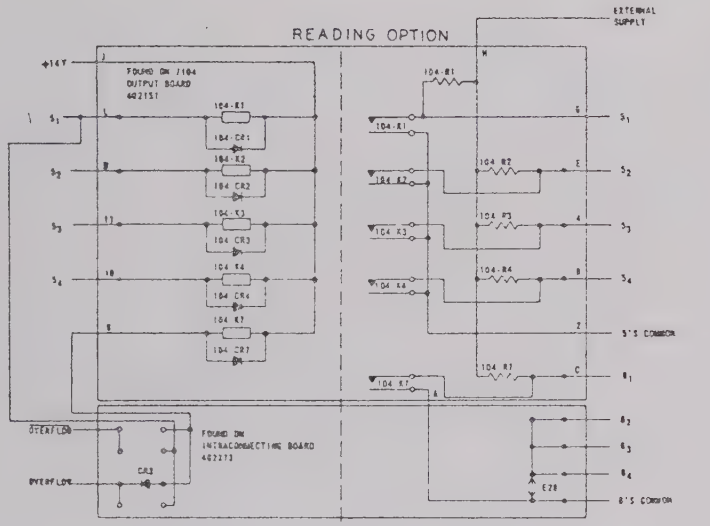
SCHEMATIC- OPTION 73-E1 & 75-E1, 1-2-4 CLOSURE TRUE

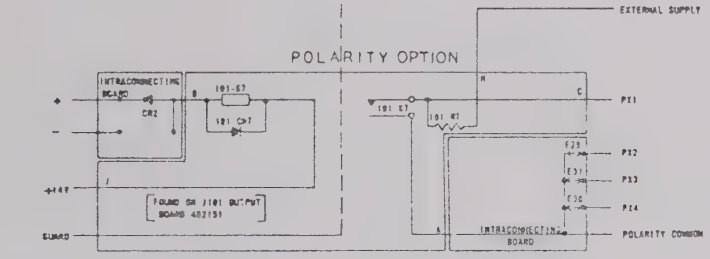
SIZE	CODE IDENT NO	DWG NO.
D	—	430599

SCALE — WT — SHEET 1 OF 1

4. RESISTORS ARE 47Ω 1/8 5% CARBON
3. ALL RELAYS ARE 310017
2. ALL DIODES ARE 818
⚠ ALL DIODE REFERENCE DESIGNATIONS ON RANGE MATRIX AND FUNCTION MATRIX ARE PREFIXED 108

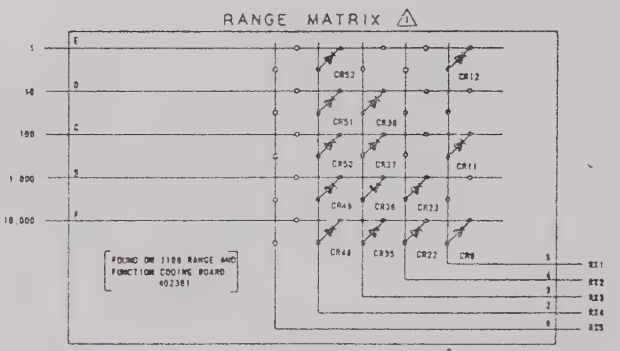
NOTES UNLESS OTHERWISE SPECIFIED

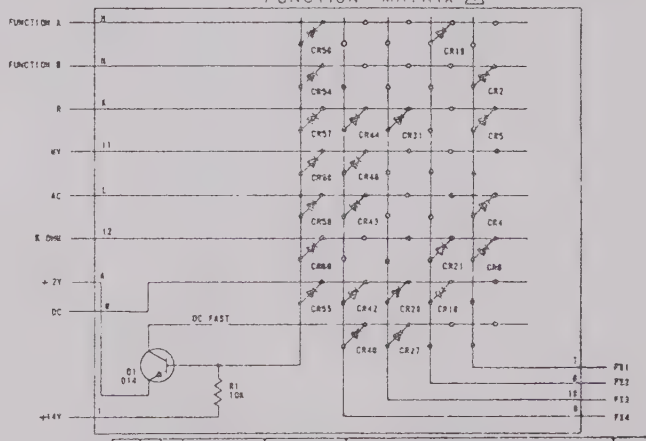




4. RESISTORS ARE 47K, 1/8.19W, 5%MOM
5. ALL DIODES ARE 31D417
2. ALL DIODES ARE 816
1. ALL DIODE REFERENCE DESIGNATIONS ON RANGE MATRIX AND FUNCTION MATRIX ARE PREFIXED 105

NOTES: UNLESS OTHERWISE SPECIFIED





QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	DOSS ENGR	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MODEL	75-E2	NEXT ASSY	USED ON
MODEL	75-E2	NEXT ASSY	USED ON
APPLICATION		NA	FA
		QTY REQD	

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .100, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED DIA TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

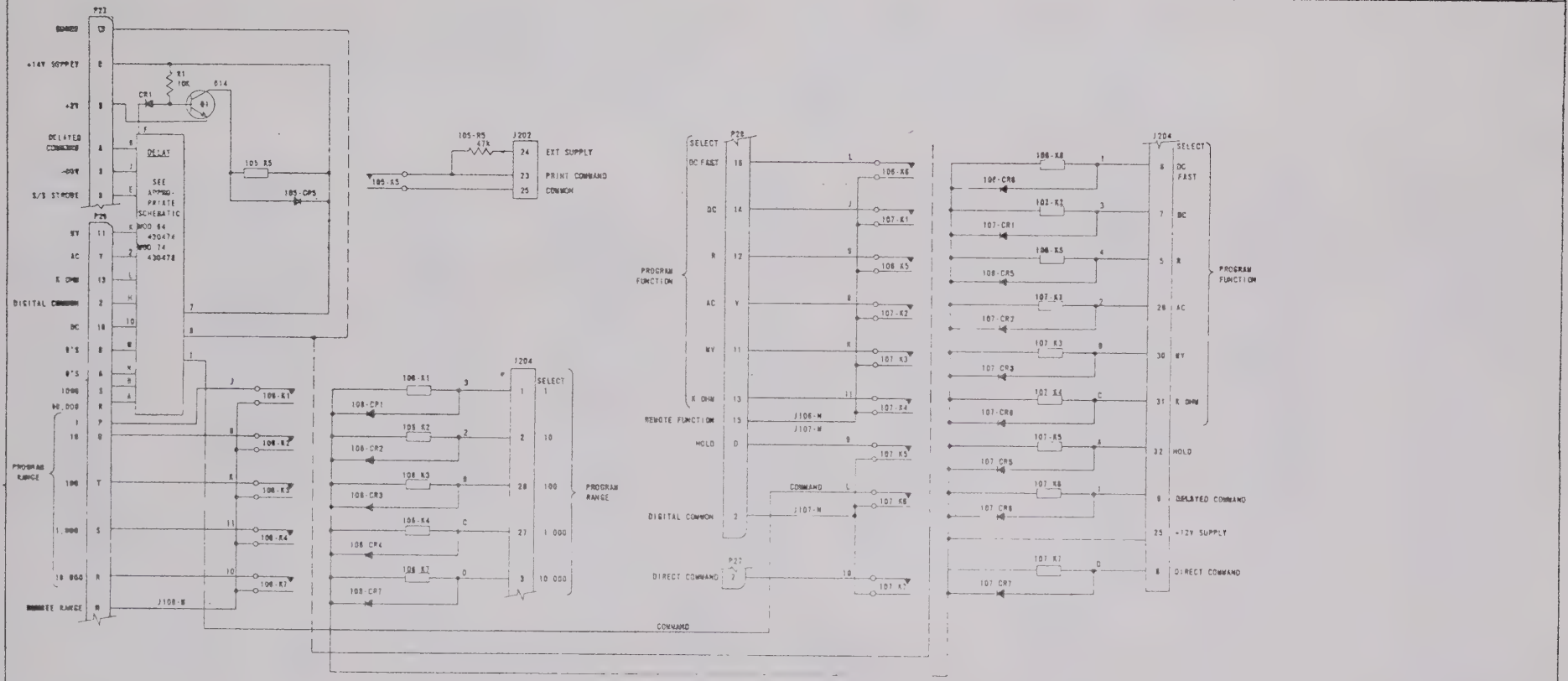
	NAME	DATE
DR	[illegible]	1-24-67
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC- OPTION 73-E2, 75-E2, 1-2-24 CLOSURE FALSE

SIZE	CODE IDENT NO.	DWG NO.
D	—	430600

SCALE — WT — SHEET 1 OF 1



NOTES UNLESS OTHERWISE SPECIFIED

1. ALL DIODES 1N4148
2. ALL RESISTORS 1/4W 5% CARBON
3. ALL RELAYS DANA P/N 310017

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

400650	74	REF	REF
400650	64	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQ'D	

MATERIAL | APPLIED FINISH | HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
.X ± .1 ± 0° 30'
.XX ± .02
.XXX ± .010
FORMED ANGLES ± 1°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED 0.010 R
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-STD-100 AND MIL-D-1000

CONTRACT NO.

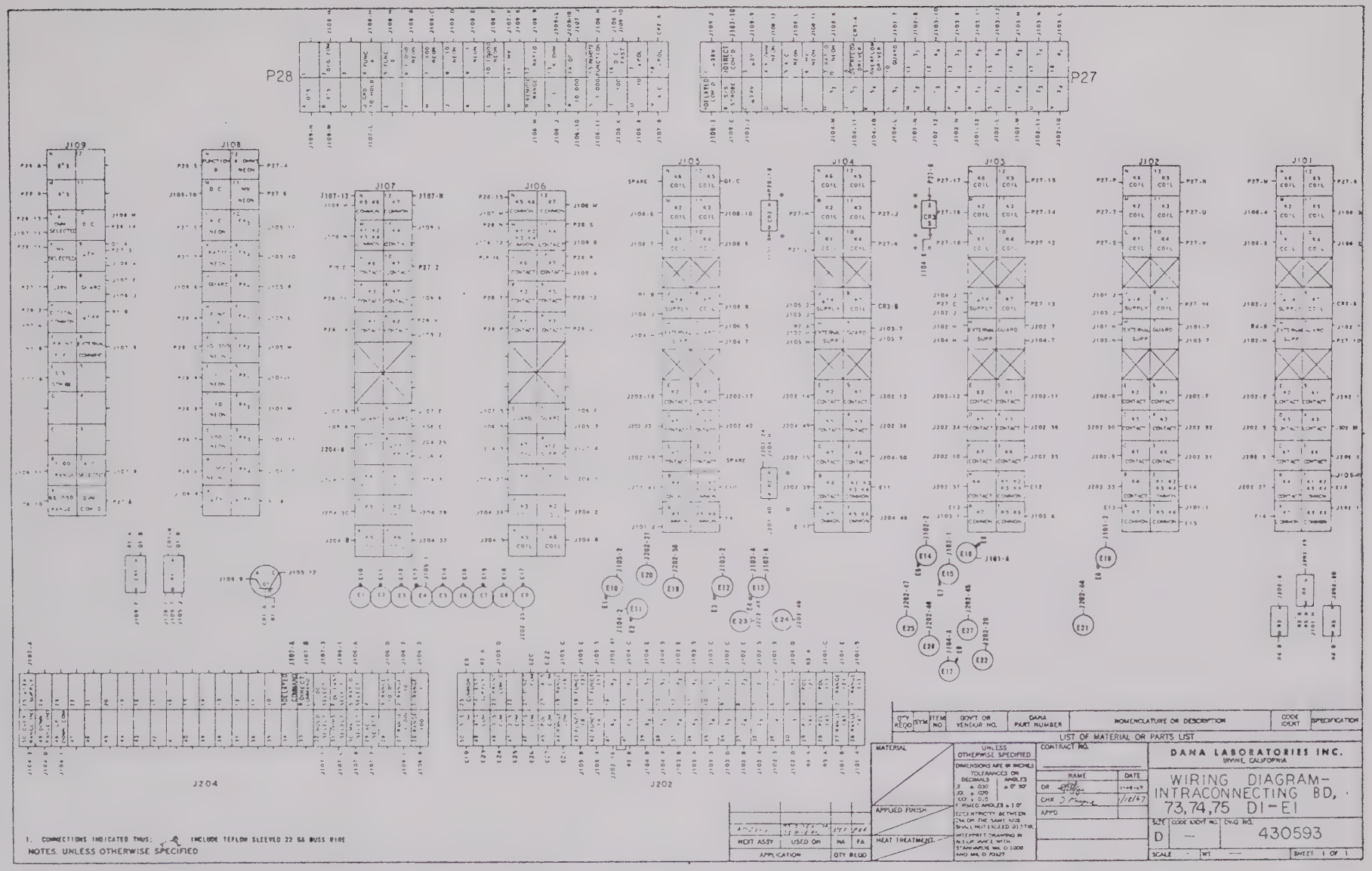
	NAME	DATE
DR	[illegible]	8/18/64
CK	D Payne	11/16/64
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC-PROGRAMMING, MODEL 64 & 74

SIZE	CODE IDENT NO	DWG NO.
D	—	430491

SCALE — | WT — | SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± 0.30, .XX ± 0.70, .XXX ± 0.5
ANGLES ± 0° 30'
FRACTIONAL ANGLES ± 0° 10'
SURFACE INTEGRITY BETWEEN ITEMS ON THE SAME PCB SHALL NOT EXCEED 0.010".
INTERPRET DRAWING IN ACCORDANCE WITH ANSI/ASME Y14.5M-1994 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		11-19-47
CHK		11-21-47
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM— INTRACONNECTING BD, 73,74,75 DI-E1

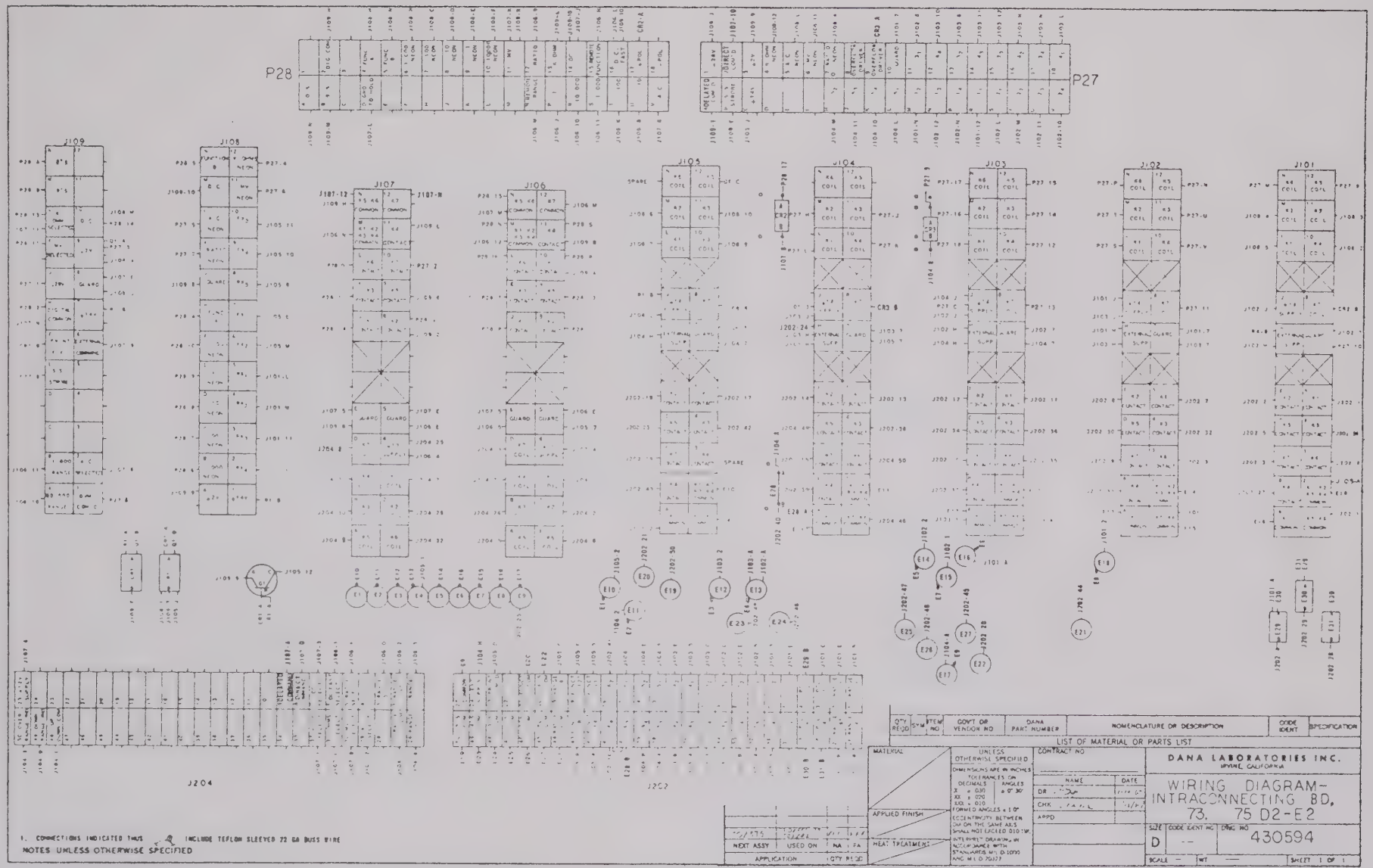
SIZE: D | CODE IDENT NO.: — | DWG NO.: 430593

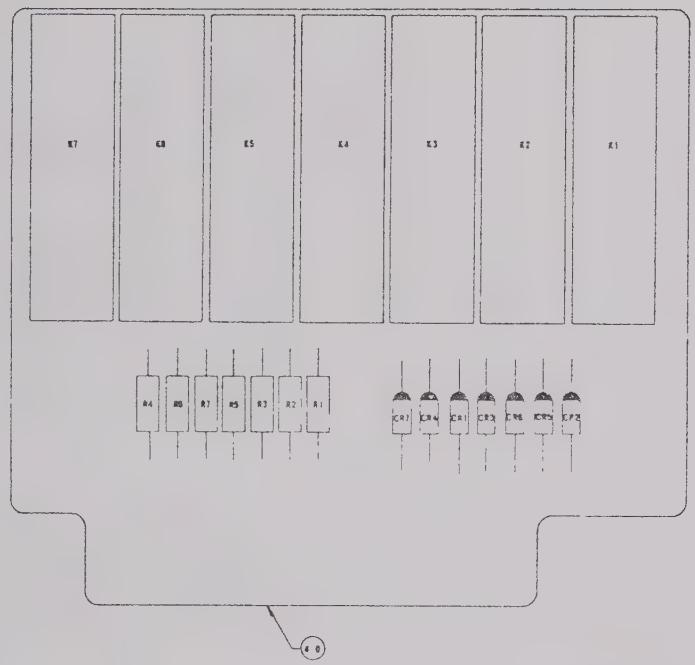
SCALE: — | WT: — | SHEET 1 OF 1

NEXT ASSY	USED ON		
APPLICATION		QTY REQD	

1. CONNECTIONS INDICATED THUS: ⌀ INCLUDE TEFLON SLEEVED 22 GA BUSS WIRE

NOTES. UNLESS OTHERWISE SPECIFIED


P28
P27
J109
J108
J107
J106
J105
J104
J103
J102
J101
J204
J202
NOTES UNLESS OTHERWISE SPECIFIED
1. CONNECTIONS INDICATED THUS INCLUDE TEFLON SLEEVED 22 GA BUSS WIRE
QTY REQD | SYM | ITEM NO | GOVT OR VENDOR NO | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS
X ± 030
XX ± 020
XXX ± 010
ANGLES ± 0° 30'
FORMED ANGLES ± 1°
CONCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327
NEXT ASSY | USED ON | NA | PA
APPLICATION | QTY REQD
CONTRACT NO
NAME | DATE
DR
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM-
INTRACONNECTING BD,
73, 75 D2-E2
SIZE D | CODE IDENT NO -- | DWG NO 430594
SCALE — | WT — | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO	PART NO
4 0	410283

REF DES	P/M ITEM	DESCRIPTION
R7	3 0	MCI E1 125
R1	3 0	MCI E1 125
CR7	2 0	D18
CR1	2 0	D18
P7	1 0	47K 1/8 5%
R1	1 0	47K 1/8 5%

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION
					LIST OF MATERIAL OR PARTS LIST		
400552	75	1	1				
400549	73	1	1				
400548	65	1	1				
400547	63	1	1				
NEXT ASSY	USED ON	MA	FA				
APPLICATION		QTY REQD					

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± ANGLES
.X ± 0.10 ± 0° 30'
.XX ± 0.0
.XXX ± 0.010
FORMED ANGLES ± 1.0°
CONCENTRICITY BETWEEN
CIRCUITRY SHALL NOT EXCEED 0.010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	[illegible]
CHK	[illegible]	10/19/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

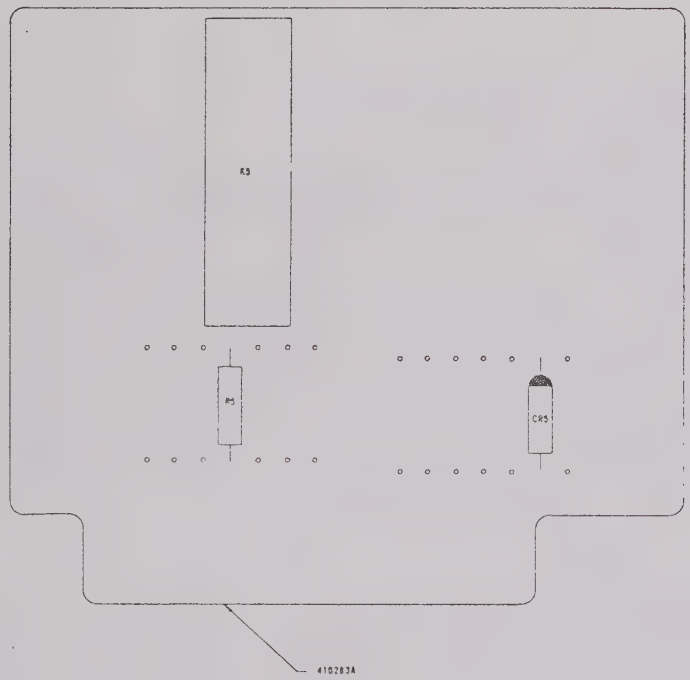
PC BOARD ASSEMBLY-
ISOLATED OUTPUT

SIZE	CODE IDENT NO	DWG NO.
D	——	402151

SCALE 4/1 WT —— SHEET 1 OF 1

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
1. SCHEMATIC REFERENCE: 430481

NOTES: UNLESS OTHERWISE SPECIFIED



REF DES	PART NO	DESCRIPTION
R5	000473	4" X 1 4 W
A5	310017	WC1 125
CR5	211083	018

2 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

1. SCHEMATIC REFERENCE: 430588

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P N	ITEM NO
		LIST OF MATERIAL OR PARTS LIST			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES FORMED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1°

CONTRACT NO.

DANA LABORATORIES INC
IRVINE, CALIFORNIA

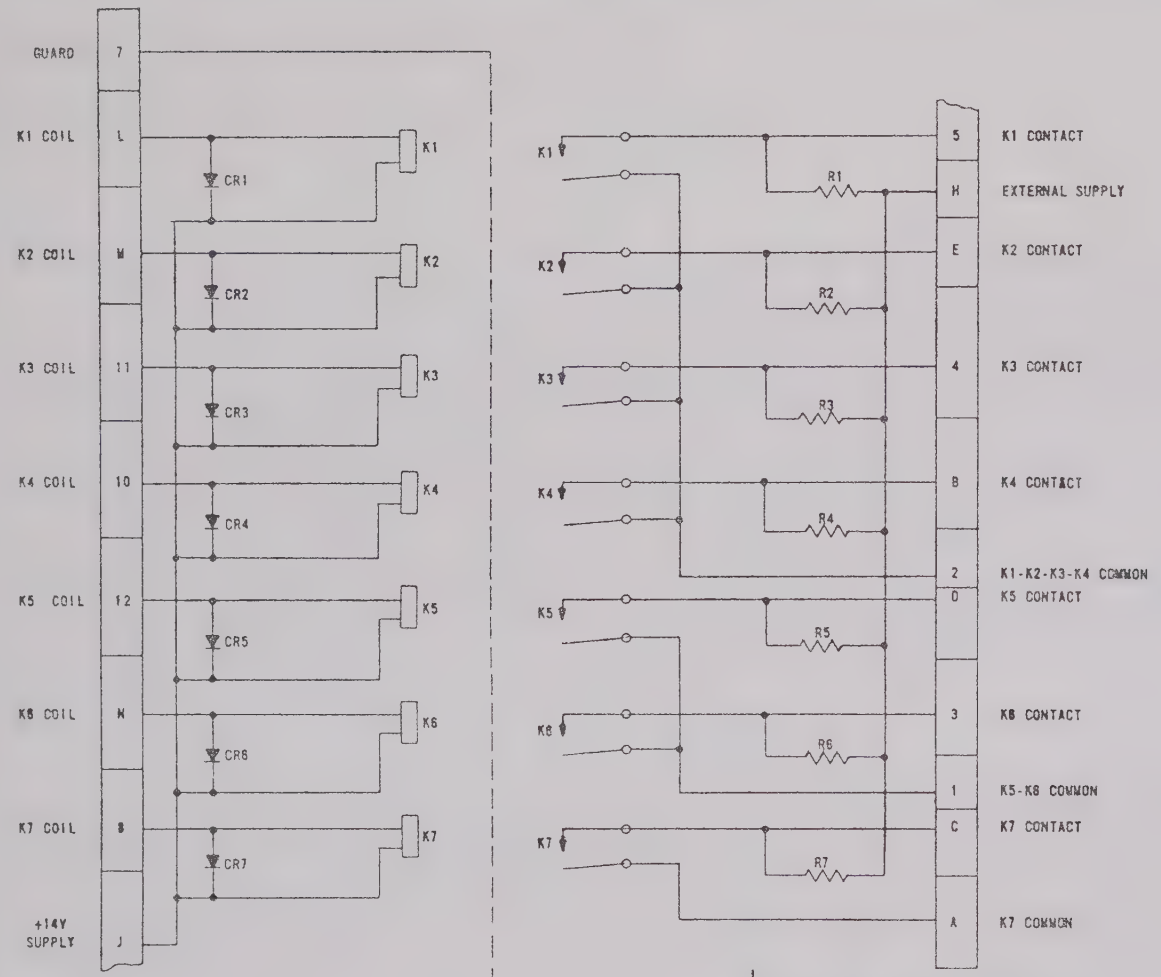
DRAWN A.WEBSTER 7-1-74
CHECK T.GUY 7-2-74
ENGR
MFG
QUAL
MATERIAL
FINISH

PC BOARD ASSY - PRINT
COMMAND MODEL 54&74

SIZE D | CODE IDENT NO — | DWG NO 402367 | REV

SCALE 4:1 | WT — | SHEET 1 OF 1

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

402.151	63, 65, 73, 75	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D 70127

CONTRACT NO.

NAME	DATE
DR [illegible]	8-4-66
CHK D. Payne	8/4/66
APPD	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

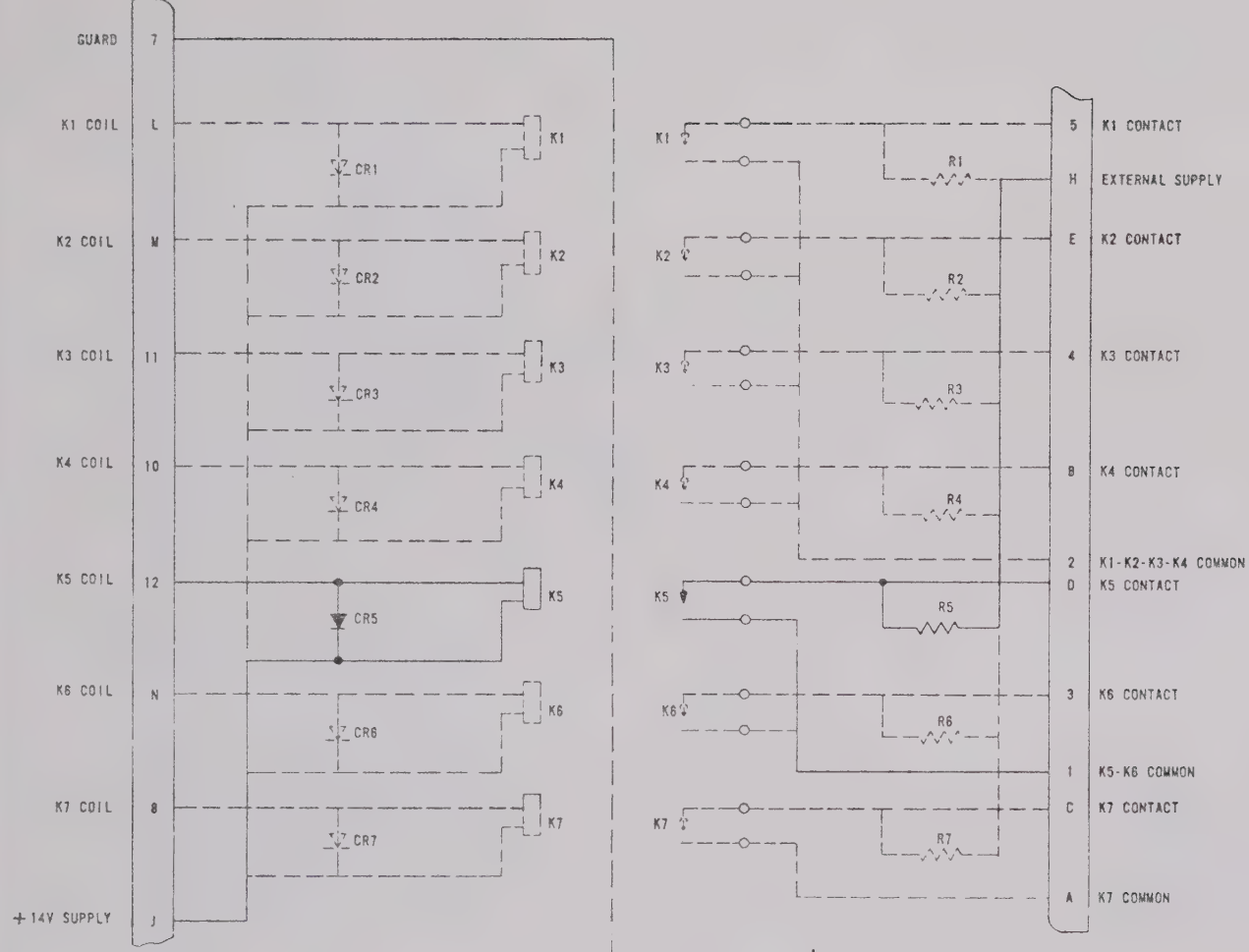
SCHEMATIC- ISOLATED OUTPUT

SIZE	CODE IDENT NO.	DWG NO.
C	—	430481

SCALE — | WT — | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

3. ALL RESISTORS ARE 47K, ¼ W, 5%, CARBON.
2. ALL DIODES ARE TYPE 018.
1. ALL RELAYS ARE MC1-12S.



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	REF	REQ
4CR367	64&74	NA	NA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS: .X ±.50, .XX ±.020, .XXX ±.010; ANGLES 0° 30'; FORMED ANGLES 1.0
MATERIAL
FINISH

CONTRACT NO.

DRAWN	ABBOTT	1/11/67
CHECK	Tait	1/11/67
COG ENGR	D. Payne	1/11/67
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

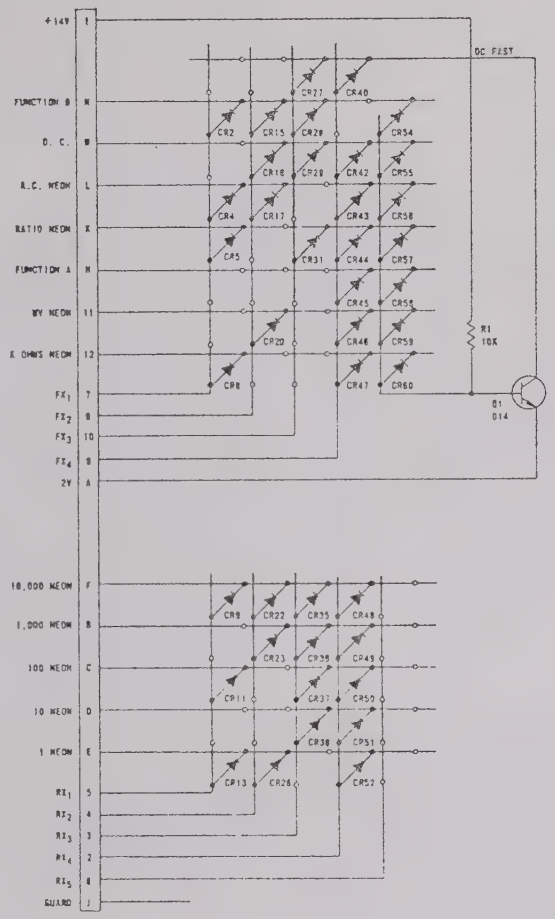
SCHEMATIC — PRINT
COMMAND, MODEL 64&74

SIZE	CODE IDENT NO.	DWG NO.	REV
C	—	430589	

SCALE -- WT — SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RELAYS ARE DANA P/N 310017
2. ALL DIODES ARE TYPE 018
3. ALL RESISTORS ARE 47K, 1/4W, 5% CARBON.



1. ALL DIODES TO BE TYPE 818.

NOTE, UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN ABBOTT 4/4/67
CHK'D [illegible] 4/4/67
COG ENGR PROJ ENGR D Hayes 4/10/67

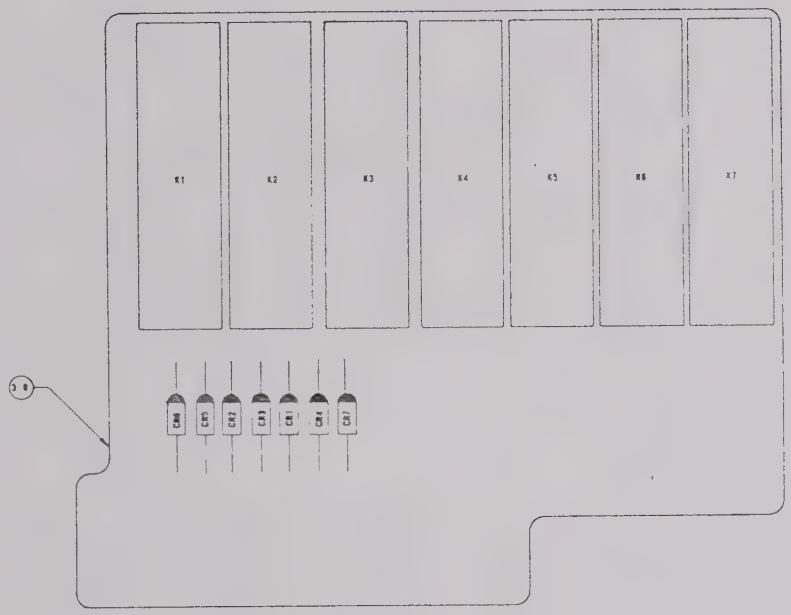
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC-RANGE FUNCTION CODING, D2 (1248 CLOSURE FALSE)

SIZE	CODE IDENT NO	DWG NO	REV
D	——	430581	

SCALE — WT —— SHEET 1 OF 1

4025-19	4/4/73-35	A/R	FA
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	



CROSS REFERENCE CHART	
ITEM NO	PART NO
J 1	410282

REF DES	ITEM	DESCRIPTION
K 7	2 0	MCI E1-12S
K 1	2 0	MCI E1-12S
CR7	1 0	D1B
CR1	1 0	D1B

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION
400552	75	1	1				
400551	74	1	1				
400548	65	1	1				
400550	54	1	1				
NEXT ASSY	USED ON	NA	FA				
APPLICATION		QTY REQD					

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
2 PLACE ± .030 ± 0° 30'
3 PLACE ± .005
FRACTIONS ± 1/64
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA OR THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	10-19-66
CHK	[illegible]	10/19/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

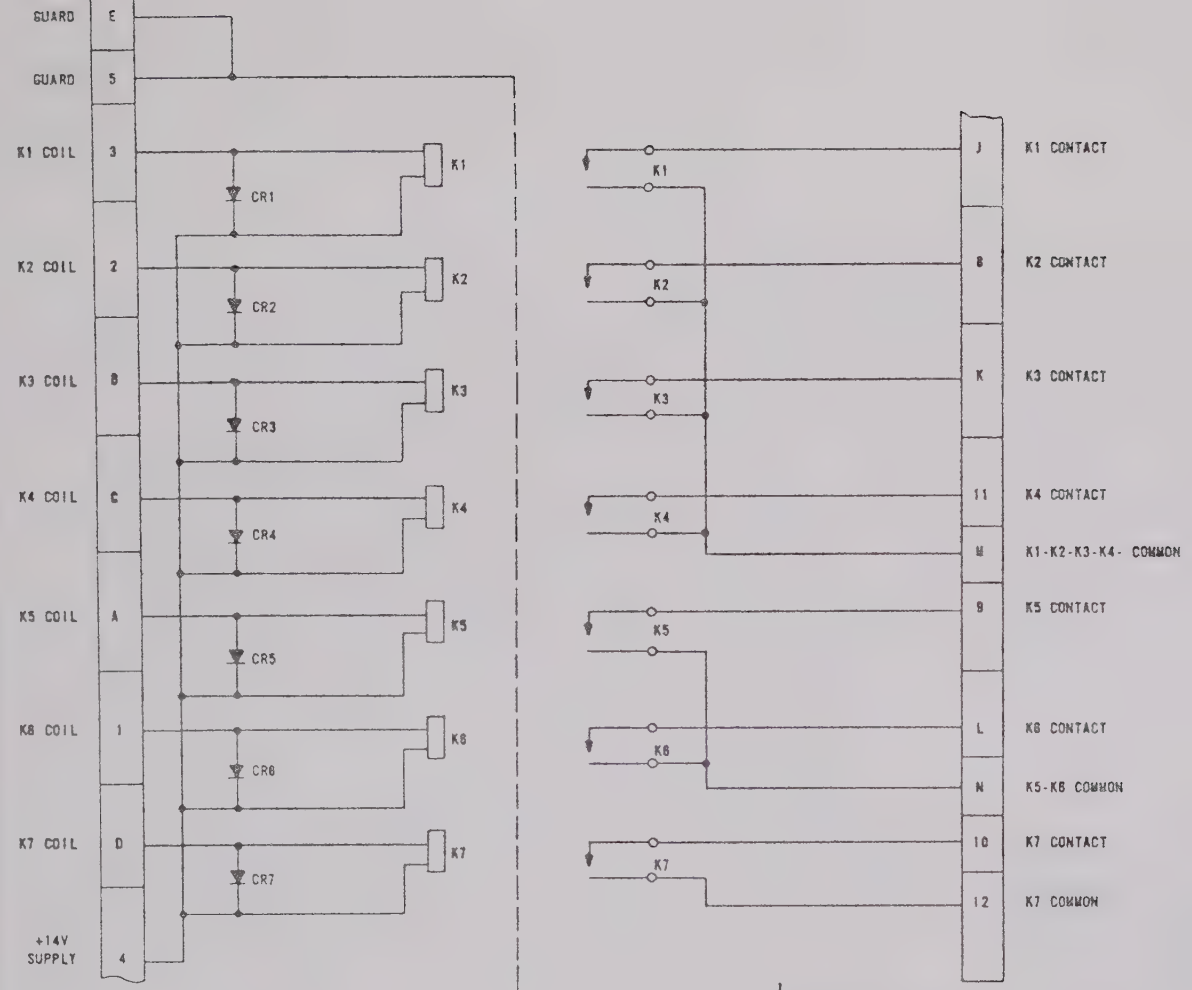
PC BOARD ASSY ISOLATED PROGRAMMING

SIZE	CODE IDENT NO	DWG NO
D	—	402150

SCALE 4/1 WT ——— SHEET 1 OF 1

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
1. SCHEMATIC REFERENCE: 470390

NOTES: UNLESS OTHERWISE SPECIFIED



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

402150	C4, C5, C4, C5	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

2. ALL DIODES ARE TYPE 018.

1. ALL RELAYS ARE MCI-12S.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

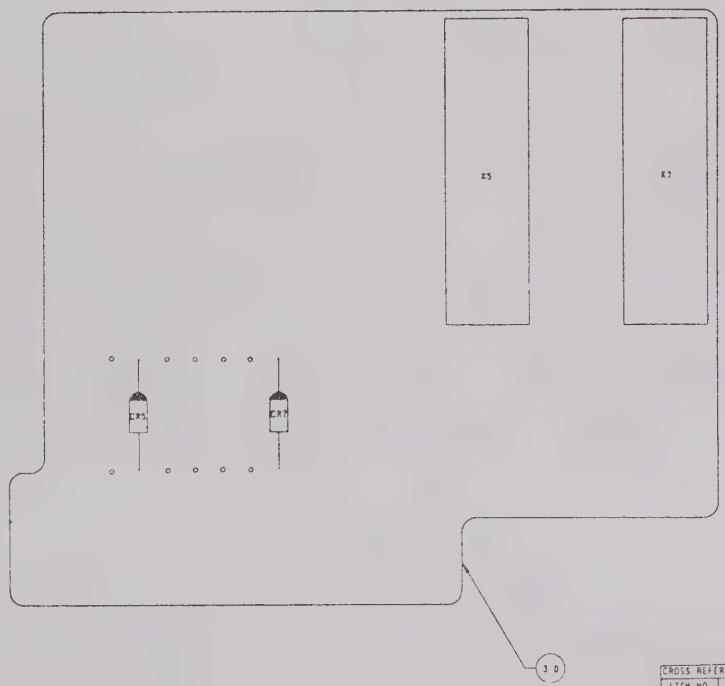
NAME	DATE
DR T. Berg	8-1-66
CHK D. Payne	8/8/66
APPD	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - ISOLATED PROGRAMMING

SIZE	CODE IDENT NO.	DWG NO.
C		430480

SCALE — | WT — | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO	PART NO
3 D	410282

X 7	2 D		MCI E1 125
X 5	2 D		MCI E1 125
CR7	1 D		D1B
CR5	1 D		D1B
REF DES	SYM ITEM		DESCRIPTION

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION
					LIST OF MATERIAL OR PARTS LIST		
400579	71-E2	/	1				
400578	72-E1	1	1				
400577	11-02	1	1				
400571	11-01	1	1				
400570	61-E2	1	1				
400569	61 E1	1	1				
400568	11-02	1	1				
400591	15-01	1	1				

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ± .005 ± .015
ANGLES ± 0° 30'
FINISHED ANGLES ± 1.0°
CONCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR		
CHK		7/11/67
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSEMBLY-
COMMAND AND HOLD

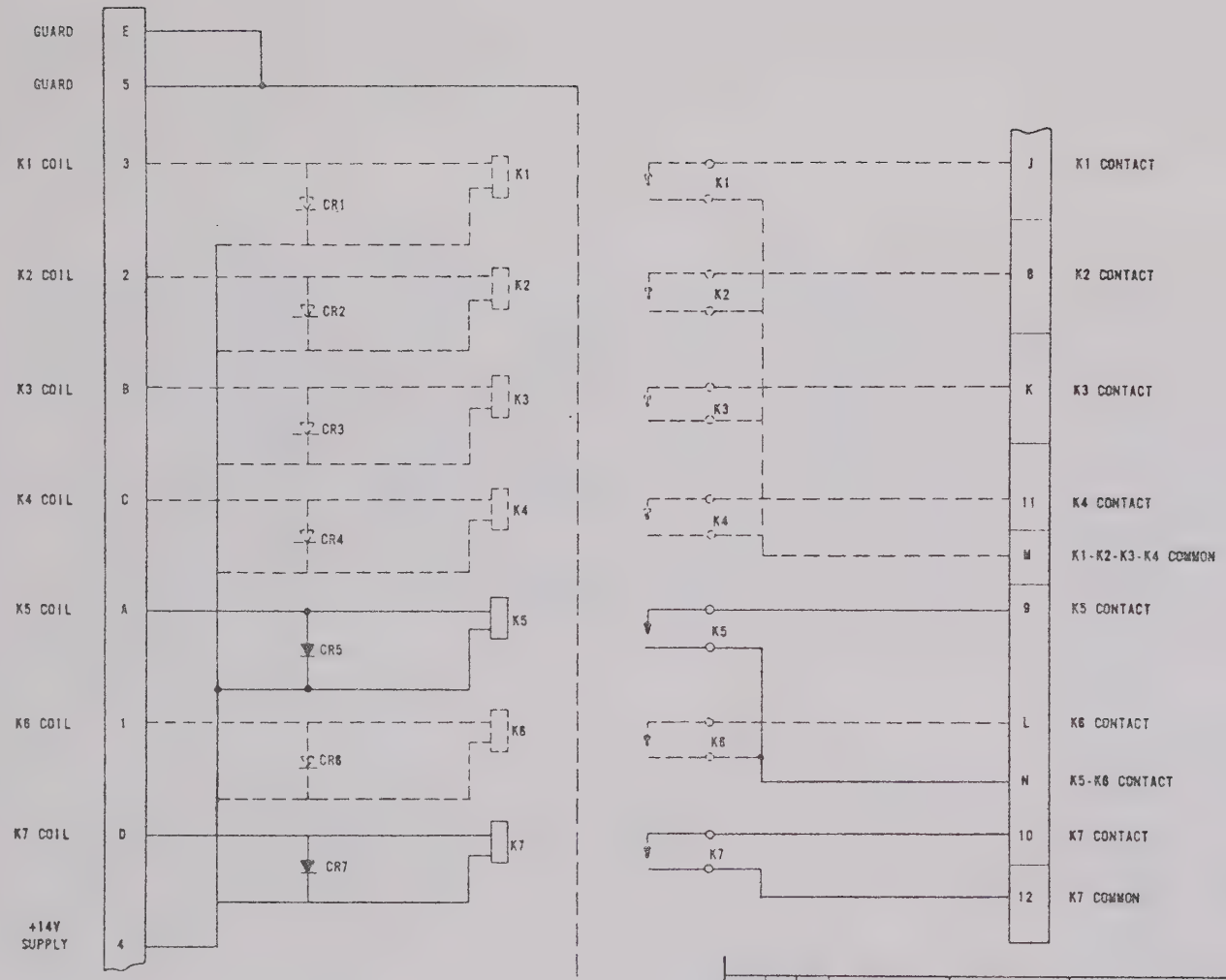
SIZE D | IDENT NO | DWG NO 402165 A

SCALE 4/1 | WT | SHEET 1 OF 1

2 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

1. SCHEMATIC REFERENCE 430471

NOTES UNLESS OTHERWISE SPECIFIED



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

402165	63,73	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	m Berg	8-4-66
CHK	D. Payne	8/8/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

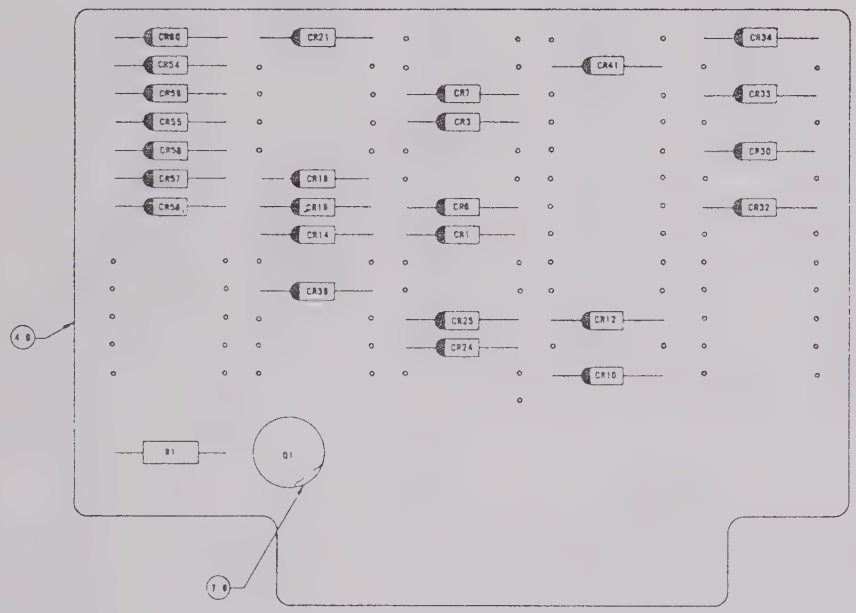
SCHEMATIC- COMMAND AND HOLD

SIZE	CODE IDENT NO.	DWG NO.
C	—	430472 A

SCALE — WT — SHEET 1 OF 1

2. ALL DIODES ARE TYPE 018.
1. ALL RELAYS ARE MC1-12S.

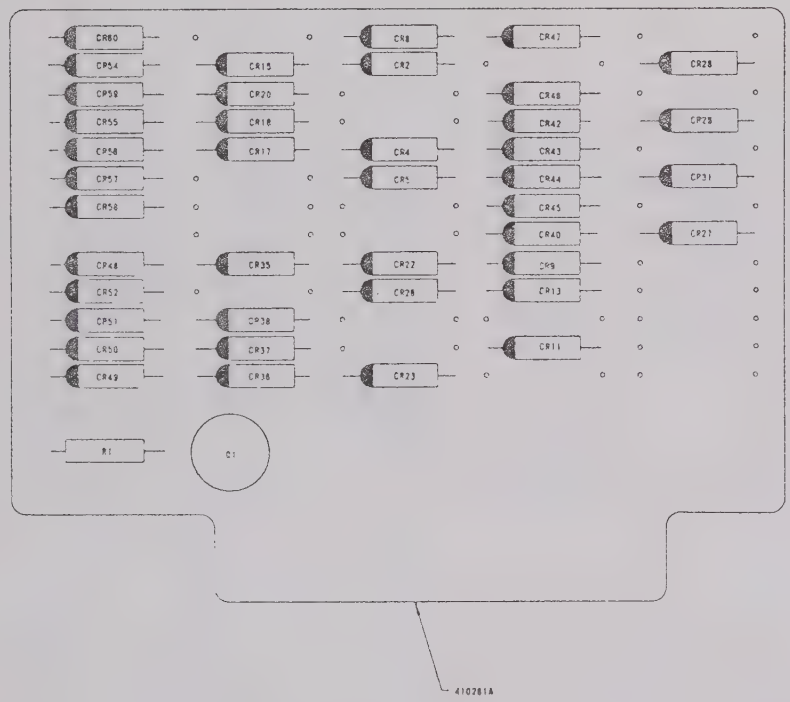
NOTES: UNLESS OTHERWISE SPECIFIED



CROSS REFERENCE CHART	
ITEM NO	PART NO
4 0	418281
7 0	920008

REF DES	A/M /FM	DESCRIPTION
CR60	3 0	018
CR59		
CR58		
CR57		
CR56		
CR55		
CR54		
CR41		
CR39		
CR34		
CR33		
CR32		
CR30		
CR25		
CR24		
CR21		
CR19		
CR18		
CR14		
CR12		
CR10		
CR 7		
CR 6		
CR 5		
CR 3	3 0	018
Q 1	2 0	014
R 1	1 0	10K ¼W 5%

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION



REF DES	PART NO	DESCRIPTION
CR52	211083	018
CR51	"	"
CR50	"	"
CR49	"	"
CR48	"	"
CR47	"	"
CR46	"	"
CR45	"	"
CR44	"	"
CR43	"	"
CR42	"	"
CR40	"	"
CR38	"	"
CR37	"	"
CR36	"	"
CR35	"	"
CR31	"	"
CR29	"	"
CR28	"	"
CR27	"	"
CR26	"	"
CR23	"	"
CR22	"	"
CR20	"	"
CR17	"	"
CR16	"	"
CR15	"	"
CR13	"	"
CR11	"	"
CR9	"	"
CR8	"	"
CR5	"	"
CR4	"	"
CR2	211083	018
R1	000103	10 A, 1/4, 5%
C1	200035	014
CR60	211083	018
CR59	"	"
CR58	"	"
CR57	"	"
CR56	"	"
CR55	"	"
CR54	211083	018

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
1. REFERENCE SCHEMATIC 430581

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P N	ITEM NO
		LIST OF MATERIAL OR PARTS LIST			

NEXT ASSY	USED ON	QTY REQD
APPLICATION		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS | ANGLES | FORMED ANGLES
.X ±.01 | 0° 30' | ±1.0
.XX ±.005
.XXX ±.002

MATERIAL

FINISH

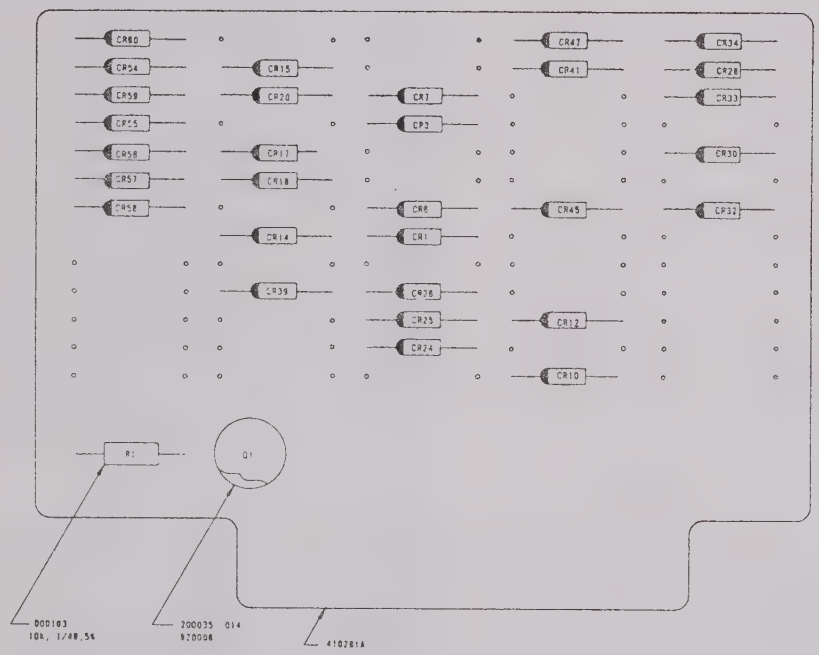
CONTRACT NO.

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY-RANGE FUNCTION CODING, D2

SIZE	FSCM IDENT NO	DWG NO	REV
D	- -	402359	

SCALE 4/1 | WT | SHEET 1 OF 1



3. ALL DIODES ARE 018
2. SCHEMATIC REFERENCE: 430582
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
402584			/	/	
430758			/	/	
430583			/	/	
430582			/	/	

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ±.1, XX ±.05, XXX ±.010 | ANGLES 0° 30' | FORMED ANGLES ±1°
MATERIAL
FINISH

CONTRACT NO

DRAWN 7/7/67
CHECK
ENGR APPR
MFG APPR

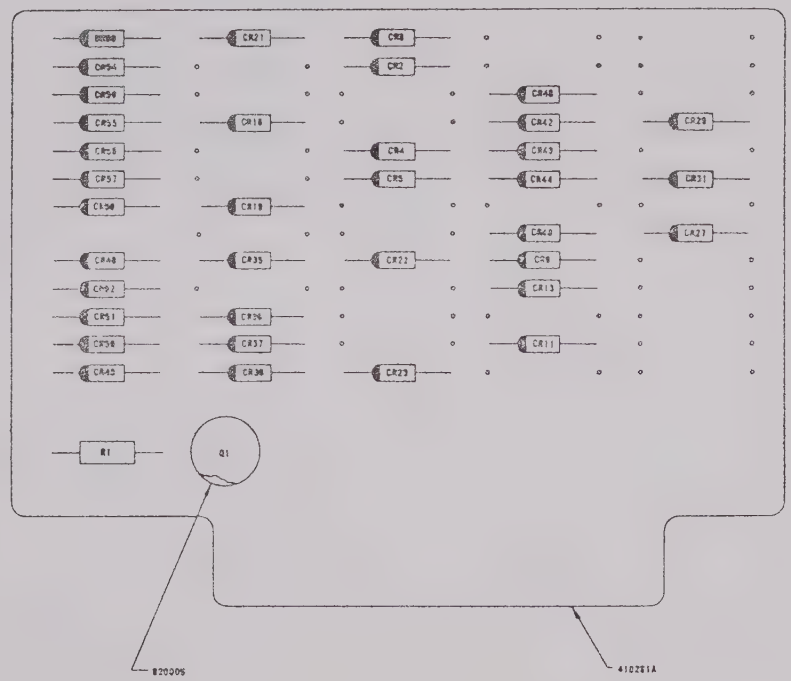
DANA LABORATORIES INC.
IRVINE CALIFORNIA

PC BOARD ASSEMBLY-RANGE AND FUNCTION CODING, EI

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

SIZE D | CODE IDENT NO —— | DWG NO 402360 | REV

SCALE 4/1 | WT —— | SHEET 1 OF 1



REF DES	PART NO	DESCRIPTION
CR56	211083	018
CR57		
CR58		
CR55		
CR54		
CR52		
CR51		
CR50		
CR49		
CR48		
CR48		
CR44		
CR43		
CR42		
CR40		
CR39		
CR37		
CR36		
CR35		
CR31		
CR28		
CR22		
CR23		
CR22		
CR21		
CR19		
CR18		
CR12		
CR11		
CR8		
CR8		
CR5		
CR4		
CR2	211083	018

REF DES	PART NO	DESCRIPTION
R1	000103	10K, 1/4W, 5%
Q1	200035	014
CR60	211083	018
CR59	211083	018

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
1	400585	MOD 75-E2	1		1
1	400579	MOD 73-E2	1		1
1	400576	MOD 65-E2	1		1
1	400570	MOD 63-E2	1		1
NEXT ASSY		USED ON	NA		FA
APPLICATION			QTY REQD		

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES FORMED ANGLES
.X ±.03 0° 30' ±.0
.XX ±.010
MATERIAL
FINISH

CONTRACT NO.

DRAWN
CHECK
ENGR
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSEMBLY - RANGE AND FUNCTION CODING, E2

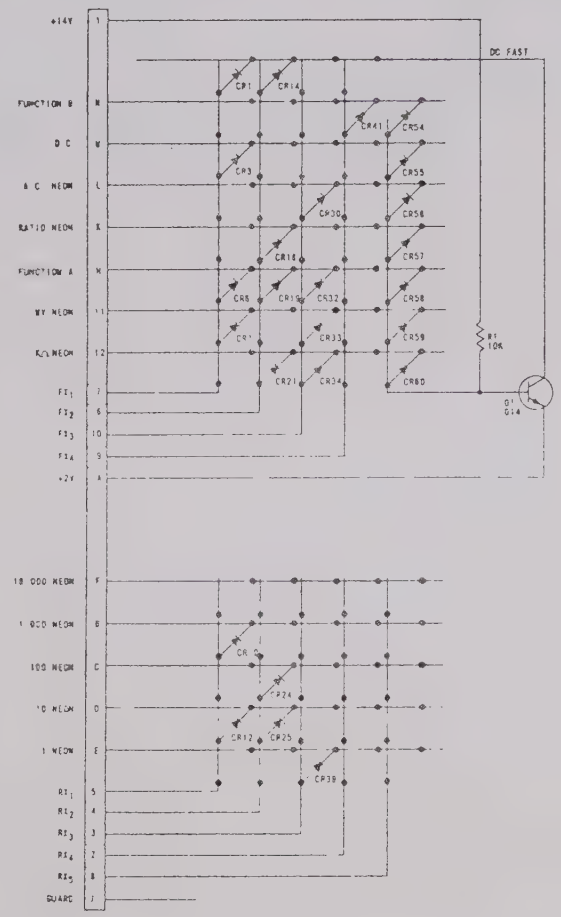
SIZE D | CODE IDENT NO | DWG NO. 402361 | REV

SCALE: 4/1 | WT | SHEET 1 OF 1

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. SCHEMATIC REFERENCE: 430083

NOTE: UNLESS OTHERWISE SPECIFIED



1 ALL DIODES TO BE TYPE G10

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQ	SYM	ITEM NO	GOVT OR VENDOR NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
X ± 0.0 ± 0° 30'
XX ± 0.00
XXX ± 0.000
ANGLES ± 1°
REMOVE ALL BURRS AND SHARP EDGES
DO NOT SCALE DRAWING
INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5
DIMENSIONS AND TOLERANCES APPLY AFTER PLATING AND FINISHING

CONTRACT NO

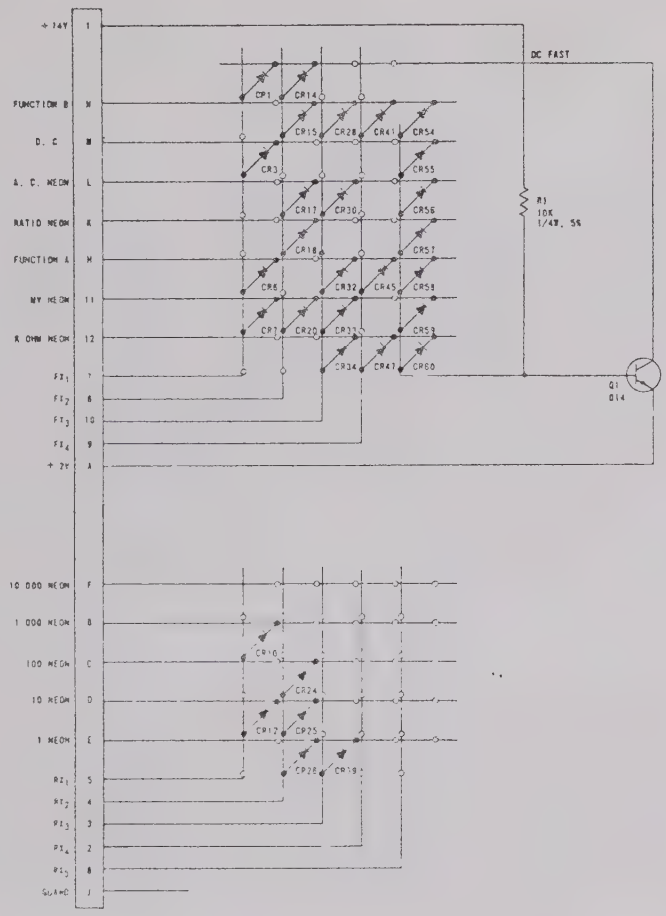
NAME	DATE
DR J MONROY	
CHK D Parry	
APPD	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - RANGE AND FUNCTION CODING
1248 NEG. TRUE

SIZE D | CAGE IDENT NO ----- | DWG NO 430479

SCALE NONE | WT -- | SHEET 1 OF 1



1 ALL DIODES TO BE TYPE D18

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ± ANGLES
.X ±.05 .XX ±.02 .XXX ±.001 FORMED ANGLES ±0° 30'
MATERIAL
FINISH
NEXT ASSY | USED ON | APPLICATION | QTY REQD

CONTRACT NO

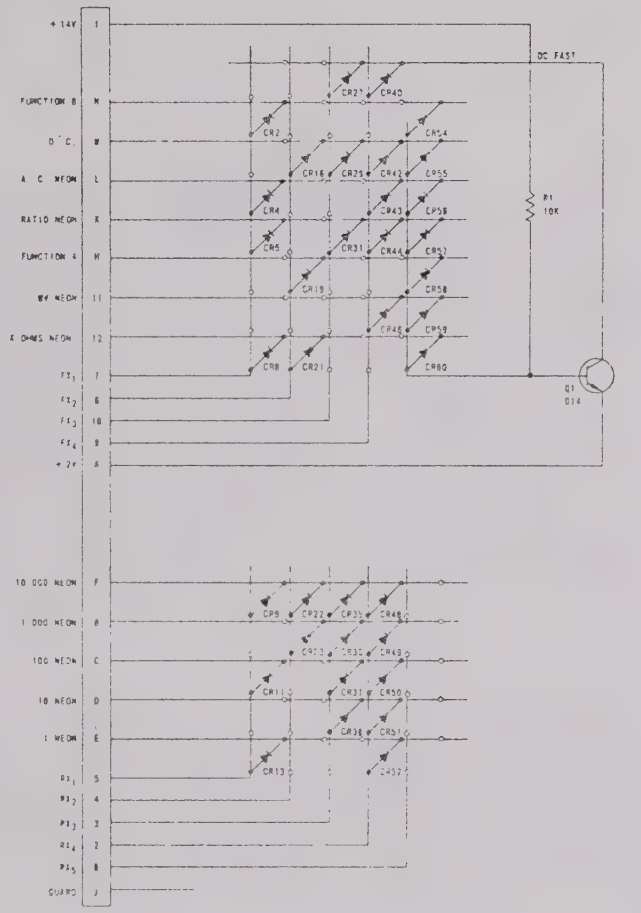
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

DRAWN	[illegible]	9-7
CHECK	[illegible]	10-30
ENG	[illegible]	11
PROJ ENGR	[illegible]	11/4/67

SCHEMATIC - RANGE & FUNCTION CODING, EI(1-2-4 CLOSURE TRUE)

SIZE	CODE IDENT NO	DWG NO	REV
D	—	430582	

SCALE — WT — SHEET 1 OF 1



2 ALL RESISTORS ARE 1/4 W 5% CARBON

1 ALL DIODES TO BE TYPE D18

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES ± .005 ± .030 FORMED ANGLES ± 1°

MATERIAL

FINISH

CONTRACT NO.

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

DRAWN 7-71 Berg
CHK'D 7-71
ENG'G
PROJ ENG'R 7-71 L Payne

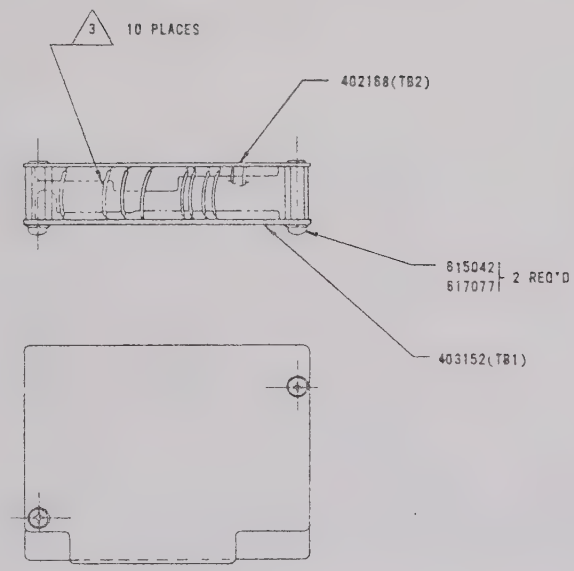
SCHEMATIC-
RANGE & FUNCTION CODING
E2(1-2-2-4 CLOSURE FALSE)

SIZE	CODE IDENT NO	DWG NO	REV
D	—	430583	

SCALE — WT — SHEET 1 OF 1

NEXT ASSY	USED ON	NA	FA
405941	5771, 5773, 5775, 5777		

APPLICATION QTY REQD



WIRE LIST					
FROM	TO	CONDUCTOR TYPE, COLOR	P/N	WIRE LGTH	NOTES
TB1-E1	TB2-E1	24GA, WHT	524999		
E2	E2				
E3	E3				
E4	E4				
E5	E5				
E6	E6				
E7	E7				
E8	E8				
E9	E9				
TB1-E10	TB2-E10	24GA. WHT	524999		

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
1	400585	75-E2			
1	400584	75-E1			
1	400583	75-D2			
1	400582	75-D1			
1	400581	74-D1			
NA	NEXT ASSY	USED ON			
QTY REQD		APPLICATION			

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .030, .XX .020, .XXX 0.10 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN Bergen Sorrell 12-19-67
CHECK T+J 12-19-67
COG. ENGR D Payne 11/13/67
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY-DELAY 15 MSEC, MODEL 74 & 75

SIZE C | CODE IDENT NO —— | DWG NO. 402171 | REV

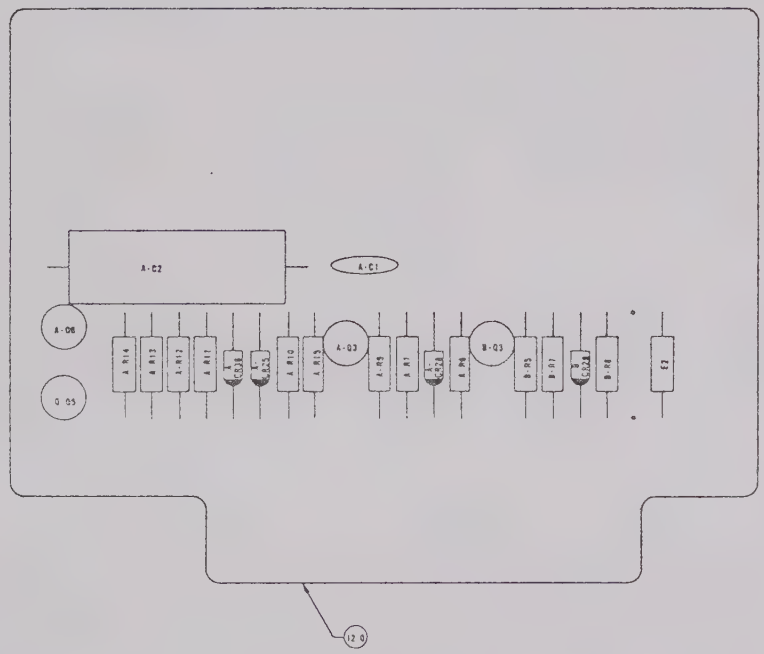
SCALE 1/1 | WT —— | SHEET 1 OF 1

3 INTERCONNECT BOARD ASSEMBLIES USING 24GA HOOK UP WIRE PER WIRE LIST.

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. SCHEMATIC REFERENCE: 430478

NOTES: UNLESS OTHERWISE SPECIFIED



E2	15 0	800245
A-CR26	11 0	018
CR26	11 0	018
A CR25	11 0	018
A Q6	19 0	2N3585
B Q5	19 0	2N3585
Q3	19 0	2N3565
A C2	9 0	1UF/100V
A C1	9 0	2200pF CERAMIC DISC
A-R15	1 0	100k
A R14	3 0	15k
A R13	8 0	8.2k
A-R12	8 0	8.2k
A R11	3 0	15k
A-R10	5 0	27k
R7	4 0	150k
R6	3 0	15k
R5	2 0	12k
REF DES	B W ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO
12 0	4102034

400579	MOD 73-C2	1	1
400578	MOD 73-E1	1	1
400577	MOD 73-02	1	1
400549	MOD 71-01	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS .XX ±.01, .XXX ±.005, ANGLES ±0° 30', FORMED ANGLES ±1°

MATERIAL

FINISH

CONTRACT NO.

DRAWN T.T. King 1-18-67

CHECK T.T. 1-18-67

COG ENGR D. Payne 1/18/67

PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

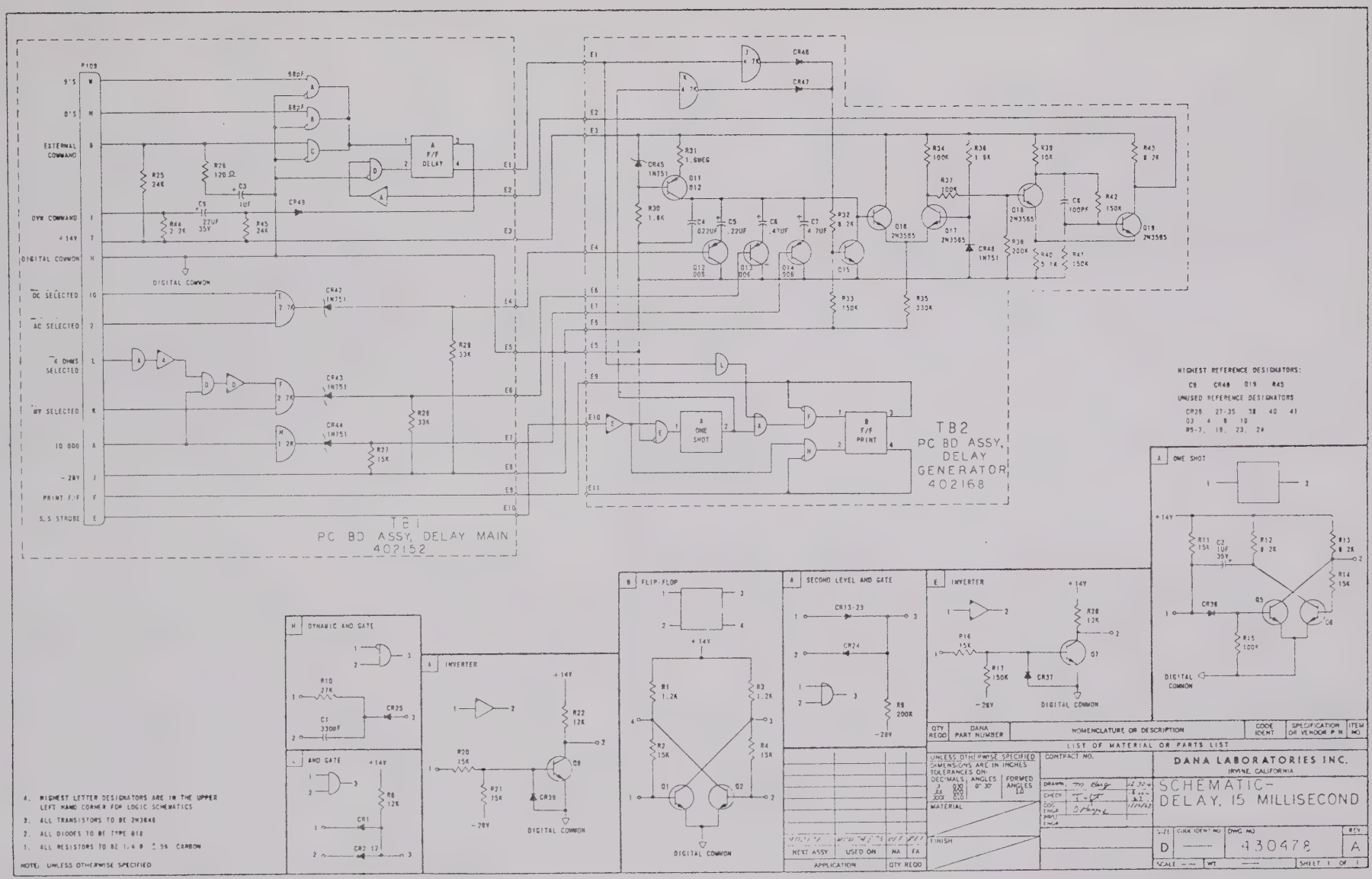
PC BOARD ASSEMBLY PRINT DELAY, 15 MILLISECOND

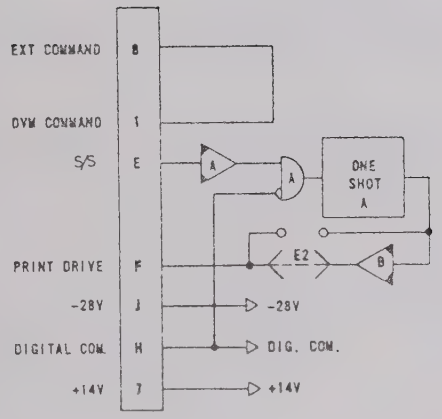
SIZE	CODE IDENT NO	DWG NO.	REV
D		402170	

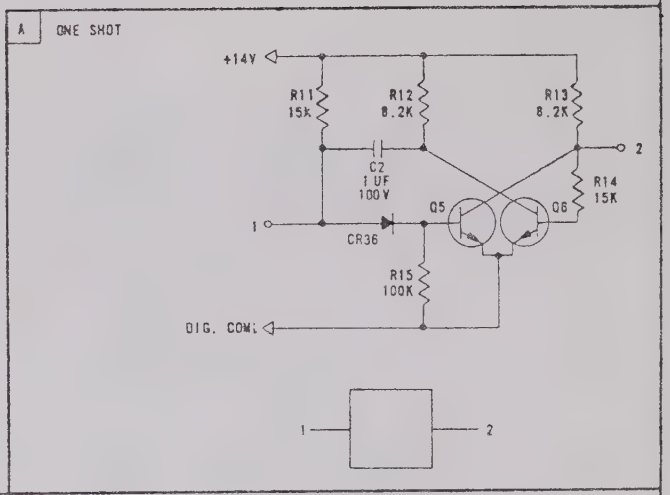
SCALE 4/1 WT SHEET 1 OF 1

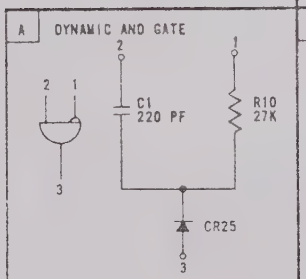
1. SCHEMATIC REFERENCE: 430477
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. ALL RESISTORS 1/4W 5%, CARBON.

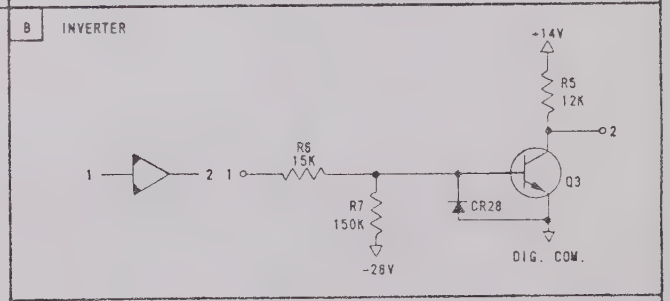
NOTE: UNLESS OTHERWISE SPECIFIED


TB1
PC BD ASSY, DELAY MAIN
402152
TB2
PC BD ASSY,
DELAY
GENERATOR
402168
A F/F DELAY
A ONE SHOT
B F/F PRINT
DIGITAL COMMON
HIGHEST REFERENCE DESIGNATORS:
C9 CR48 Q19 R45
UNUSED REFERENCE DESIGNATORS
CR28 27-35 38 40 41
Q3 4 8 10
R5-7, 19, 23, 24
4. HIGHEST LETTER DESIGNATORS ARE IN THE UPPER LEFT HAND CORNER FOR LOGIC SCHEMATICS
3. ALL TRANSISTORS TO BE 2N3646
2. ALL DIODES TO BE TYPE 818
1. ALL RESISTORS TO BE 1.4 W ± 5% CARBON
NOTE: UNLESS OTHERWISE SPECIFIED
LIST OF MATERIAL OR PARTS LIST
QTY REQD
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
CODE IDENT
SPECIFICATION OR VENDOR P/N
ITEM NO
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS ANGLES FORMED ANGLES
CONTRACT NO.
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-
DELAY, 15 MILLISECOND
MATERIAL
FINISH
NEXT ASSY
USED ON
NA
APPLICATION
QTY REQD
SIZE
CODE IDENT NO
DWG NO
REV
D
430478
A
SCALE
WT
SHEET 1 OF 1









QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

6. R11 AND C2 TO BE SELECTED TO ACHIEVE 12 M.SEC. DELAY.
5. HIGHEST LETTERED DESIGNATORS ARE IN THE UPPER LEFT HAND CORNER FOR LOGIC SCHEMATICS.
4. HIGHEST NUMBERED REFERENCE DESIGNATORS:
   R16 CR37
   C3 Q6
3. ALL TRANSISTORS TO BE 2N3646
2. ALL DIODES TO BE TYPE D18.
1. ALL RESISTORS TO BE ¼ W. 5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
102170	73D-1, 73E-1	/	/
APPLICATION		QTY REQD	

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS | ANGLES
X ± .030 | ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

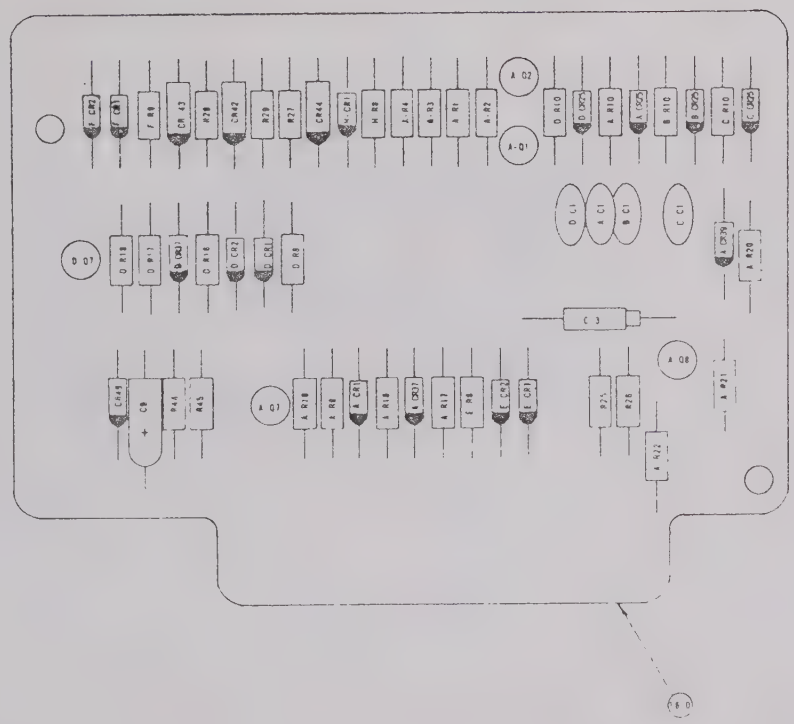
	NAME	DATE
DR	J. MONROY	8 AUG 66
CHK	O. Payne	8/8/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC PRINT
DELAY, 15 MILLISECOND

SIZE	CODE IDENT NO.	DWG NO.
C		430477

SCALE NONE | WT | SHEET 1 OF 1



REF DES	B/M ITEM	DESCRIPTION
R16	5.0	15K
R10	9.0	27K
M-R9	3.0	1.2K
F-R8	8.0	2.7K
E-R8	8.0	2.7K
D R8	11.0	8.2K
R8	4.0	12K
A-R8	11.0	8.2K
R4	5.0	15K
R3	3.0	1.2K
R2	5.0	15K
R1	3.0	1.2K
CR49	16.0	018
CR44	17.0	1N751
CR43	17.0	1N751
CR42	17.0	1N751
CR39	16.0	018
CR33		
CR25		
CR1	16.0	018
C9	12.5	22UF 35V
C3	13.0	1 UF
B C1	11.5	68pF
A C1	11.5	68pF
C 1	12.0	330 PF

REF DES	B/M ITEM	DESCRIPTION
Q8	15.0	2N3648
Q7	15.0	2N3648
Q2	5.0	2N3646
Q1	5.0	2N3646
R45	7.0	24K
R44	8.5	2.2K
R39	17.0	33K
R8	10.0	33K
R27	5.0	15K
R26	7.0	120 OHM
R25	7.0	24K
R22	4.0	12K
R21	10.5	25K
R20	5.0	15K
R18	4.0	12K
R17	6.0	150K

CROSS REFERENCE CHART	
ITEM NO	PART NO
18.0	4102900

4 SCHEMATIC REFERENCE FOR DELAY BRD 80 IDENTICAL OR 430474 (3W5) AND 430478 (12W5)

3 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

2 ALL DIODES TO BE 018

1 ALL RESISTORS TO BE 1/4W 5% CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

QTY PEQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
		LIST OF MATERIAL OR PARTS LIST			

402373	74	75	
402548	54	85	
NEXT ASSY	USED ON		NA FA
APPLICATION			QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES FORMED BY MACHINED SURFACES

MATERIAL

FINISH

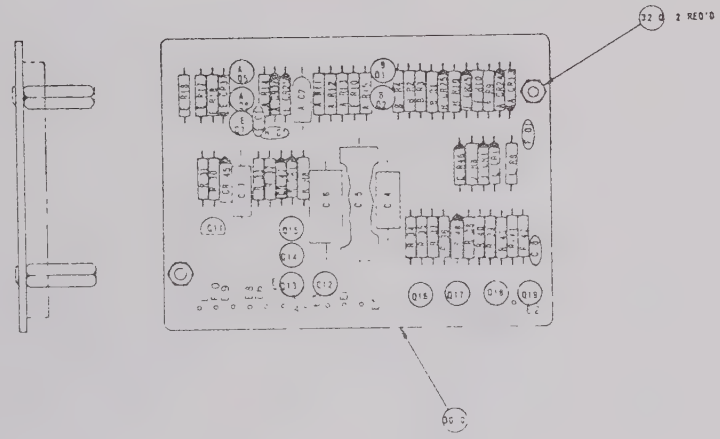
CONTRACT NO

DANA LABORATORIES INC
IRVINE CALIFORNIA

P.C. BOARD - DELAY, MAIN

SIZE D | DWG NO 402152 | REV B

SCALE 4:1 | WT | SHEET OF 1



REF DES	ITEM	DESCRIPTION
R16	8 0	15 K
R15	2 0	100 K
R14	8 0	15 K
R13	15 0	8 2 K
R17	15 0	8 2 5
R11	6 5	10 K 1/4 W
R10	11 0	27 K
R9	10 0	200 K
R8	13 0	4 7 K
R7	13 0	4 7 K
R6	4 0	12 K
R4	8 0	15 K
R3	3 0	1 2 K
R2	6 0	15 K
R1	3 0	1 2 K
CR48	28 0	1N751
CR47	27 0	D1A
CR46	27 0	D1A
CR45	28 0	1N751
CR33	27 0	D1A
CR26	↓	↓
CR25		
CR24		
CR13		
CR	27 0	D1A
C8	17 5	100 PF
C7	18 5	4 7 UF 35V
C6	20 0	47 UF 100V
C5	21 0	22 UF 100V
C4	22 0	022 UF 100V
C2	17 7	22UF 35V
C1	17 0	300 PF

REF DES	ITEM	DESCRIPTION
Q19	25 0	2N3585
Q18	↓	↓
Q17		
Q16	25 0	2N3585
Q15	24 0	2N3646
Q14	26 0	006
Q13	↓	↓
Q12	26 0	006
Q11	23 0	012
Q7	24 0	2N3646
Q6	↓	↓
Q5		
Q2		
Q1	24 0	2N3646
R43	15 0	8 2 K
R42	7 0	150 K
R41	7 0	150 K
R40	14 0	5 1 K
R39	1 0	10 K
R38	1 0	10 K
R37	2 0	30 K
R36	8 0	5 K
R35	12 0	330 K
P34	2 0	100 K
R33	7 0	150 K
R32	15 2	8 2 K
R31	1 5	1 6 MEG
R30	8 0	1 8 K
R18	4 0	12 K
R17	7 0	150 K

CROSS REFERENCE CHART	
ITEM NO	PART NO
30 0	410260 B
32 0	810140

4 SCHEMATIC REFERENCE # 430474

3 ASSEMBLY PROCEDURES & PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

2 ALL DIODES TO BE 819

1 ALL RESISTORS TO BE 1/4 W. ± 5% CARBON

NOTE UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
		LIST OF MATERIAL OR PARTS LIST			

402148	64, 65	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY PER	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES FORMED ANGLES

CONTRACT NO.

DRAWN R WOOD

CHECK

ENG

MATERIAL

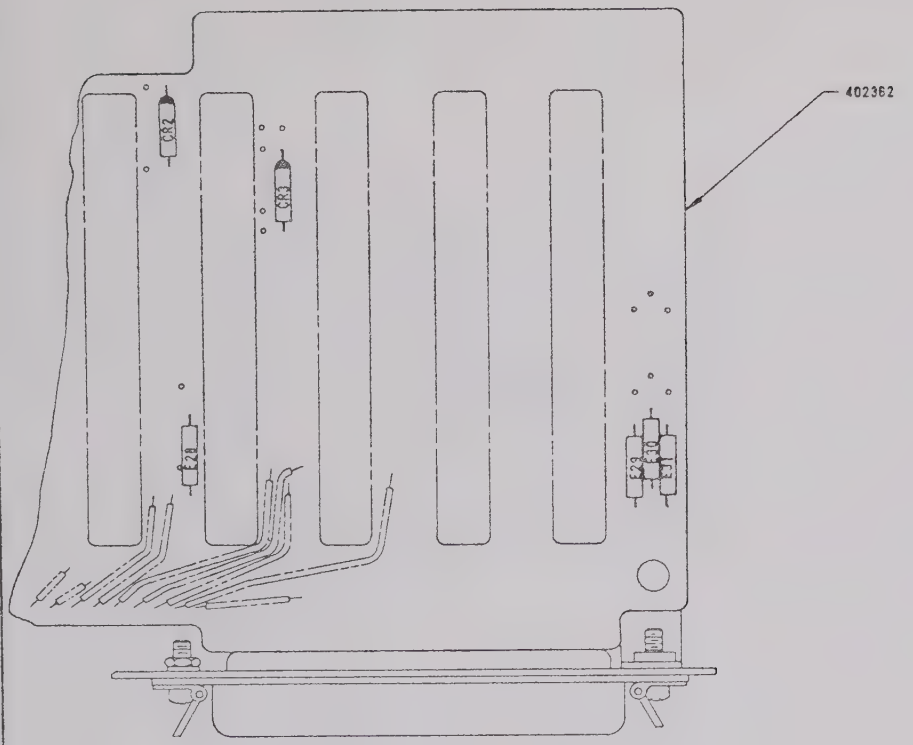
FINISH

DANA LABORATORIES INC
IRVINE CALIFORNIA

PC BOARD ASS'Y— DELAY GENERATOR, 3MS

SIZE	CODE IDENT NO	DWG NO	REV
D	—	402153	A

SCALE 2/1 WT — — SHEET 1 OF 1



REF DES	PART NO.	DESCRIPTION
E31	800248	JUMPER INSULATED
E30	"	"
E29	"	"
E28	800248	JUMPER INSULATED
CR3	211083	018
CR2	211083	018

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
400585	75-E2	1	1		
400583	75-D2	1	1		
400579	73-E2	1	1		
400577	73-D2	1	1		
NEXT ASSY	USED ON	NA	FA		
APPLICATION		QTY REQD			

LIST OF MATERIAL OR PARTS LIST

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. REFERENCE: WIRING DIAGRAM 430594

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .020, XX .020, XXX .010
ANGLES 0° 30'
FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

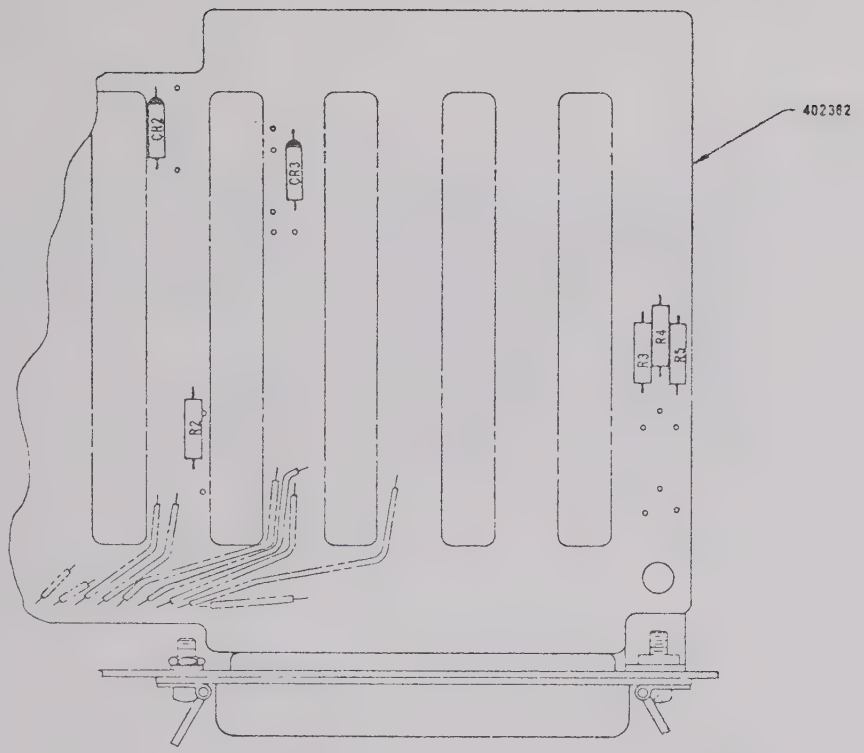
DRAWN	ABBOTT	1/9/67
CHECK	Toft	27 JAN 67
COG. ENGR	D Payne	1/27/67
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY
INTRACONNECTION,
MOD 73, 75 OUTPUT D2-E2

SIZE	CODE IDENT NO.	DWG NO.	REV
C	——	402373	

SCALE 2/1 | WT —— | SHEET 1 OF 1



R5	000473	47 k
R4	〃	〃
R3	〃	〃
R2	000473	47 k
CR3	211083	018
CR2	211083	018
REF DES	PART NO.	DESCRIPTION

400584	75-E1	1	1
400552	75-D1	1	1
400578	73-E1	1	1
400549	73-D1	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .030, XX .020, XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN	ABBOTT	1/19/67
CHECK	Toft	21 JAN 67
COG ENGR	D Payne	1/24/67
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

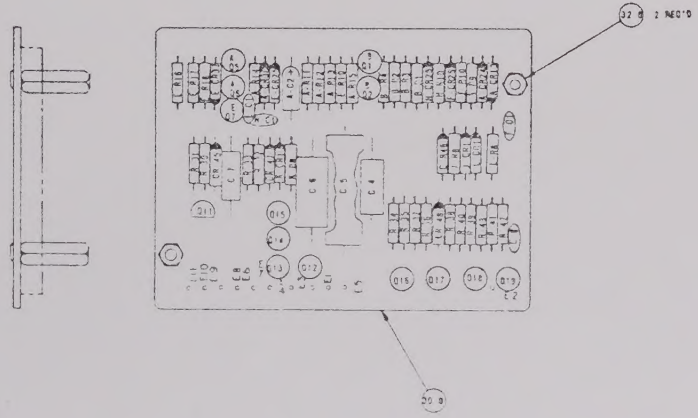
PC BOARD ASSY — INTRACONNECTION, MOD 73,74,75 OUTPUT DI-E1

SIZE	CODE IDENT NO.	DWG NO.	REV
C	—	402188	

SCALE 2/1 | WT — | SHEET 1 OF 1

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
2. ALL RESISTORS 1/4W, 5%, CARBON.
1. REFERENCE: WIRING DIAGRAM 430593

NOTES: UNLESS OTHERWISE SPECIFIED.



R16	6.0	15 K					
R15	2.0	100 K					
R14	5.0	15 K					
R13	15.0	8.2 K					
R12	15.0	8.2 K					
R11	6.0	154					
R10	31.0	27 K					
R9	10.0	200 K					
R8	13.0	4.7 K					
R7	13.0	4.7 K					
R6	14.0	12 K					
R4	6.0	15 K					
R3	3.0	1.2 K					
R2	6.0	15 K					
R1	3.0	1.2 K					
CR48	28.0	1N751					
CR47	27.0	D18					
CR46	27.0	D18					
CR45	28.0	1N751					
CR37	27.0	D18					
CR36	↓	↓					
CR25							
CR24							
CR13							
CR1	27.0	D18					
C8	17.5	100 PF					
C7	19.5	4.7 UF 35V					
C6	20.0	47 UF 100V					
C5	21.5	22 UF 100V					
C4	22.5	.022 UF 100V					
C2	19.0	1 UF 35V					
C1	17.0	300 PF					

REF DES	A-M ITEM	DESCRIPTION
Q19	25.0	2N3565
Q18	↓	↓
Q17	↓	↓
Q16	35.0	2N3585
Q15	24.0	2N3646
Q14	26.0	D08
Q13	↓	↓
Q12	26.0	D08
Q11	23.0	D12
Q7	24.0	2N3648
Q6	↓	↓
Q5		
Q2		
Q1	24.0	2N3648
R43	15.0	8.2 K
R42	7.0	150 K
R41	7.0	150 K
R40	14.0	5.1 K
R39	1.0	10 K
R38	10.0	290 K
R37	2.0	100 K
R36	8.0	1.8 K
R35	12.0	330 K
R34	2.0	100 K
R33	7.0	150 K
R32	15.2	8.2 K
R31	7.5	1.6 MEG
R30	8.0	1.8 K
R18	4.0	12 K
R17	7.0	150 K

REF DES	A-M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO	PART NO.
30.0	410280 B
32.0	810140

4. SCHEMATIC REFERENCE #420478
3. ASSEMBLY PROCEDURES & PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
2. ALL DIODES TO BE D18
1. ALL RESISTORS TO BE 1/4 W, ± 5%, CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO
		LIST OF MATERIAL OR PARTS LIST			

402171	74 35	1	1	
NEXT ASSY	USED ON	NA	FA	
APPLICATION		QTY REQD		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X .01, XX .005, XXX .010 | ANGLES 0° 30' | FORMED ANGLES ±2°

MATERIAL

FINISH

CONTRACT NO.

DRAWN Jay King 1-20-67
CHECK 70 JAN 67
QUAL MGR
PROJ ENGR D. Phillips 1-26-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASS'Y — DELAY GENERATOR, 15MS

SIZE	DWG NO	REV
D	402168	

SCALE 2/1 | WT | SHEET 1 OF 1

MP MASTER
MA30582